ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXIX. No. 10.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK.....217, 237
TECHNICAL ARTICLES:
80,000-lb. Hopper Bottom Coal Car; Chicago, Burlington & Quincy R. R. (*illustrated*)..... 218
Sewage Purification in America.—Hastings, Neb. (*with inset*)..... 218
Champion Steel Rock Crusher (*illustrated*)..... 220
The Water Filtration Plant at Leeuwarden, Holland (*with inset*)..... 220
The Crane Fire Hydrant (*illustrated*)..... 221
The Development of Technical Societies..... 221
The Construction and Maintenance of Howe Truss Bridges..... 222
A Variable Speed Pulley (*illustrated*)..... 223
An Interesting Example of False Work Construction (*illustrated*)..... 223
The Monte Generoso Rack Railway..... 234
Chicago's Solution of the Grade Crossing Problem (*illustrated*)..... 233
Notes from the Engineering Schools..... 233
Railway Earnings in 1892..... 234
The Monument Creek Reservoir, Colorado (*illustrated*)..... 235
Cost of Vitrified Pipe Sewers at Gardner, Mass..... 235
The Use of Burlaps for Levee Protection During High Water..... 235
Compound Express Locomotive, Jura-Simplon Ry., Switzerland (*illustrated*)..... 236
Two English Electric Railways..... 236
The back Piling of Water..... 237
Weather Table, January..... 237
PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS..... 225
EDITORIAL NOTES..... 228
Sewage Purification—Development of Technical Societies—Cost of Fuel on Electric Railways—Growth of Electric Railways in Country Districts.
EDITORIALS:
Uniformity in Freight Car Draft Gear..... 229
The Tendency of Population into Cities..... 230
LETTERS TO THE EDITOR..... 231
The Actual Resistance of Bearing Piles—The Cause of the Hamburg Cholera Epidemic—Thickness of Retaining Walls—Switch Leads (*illustrated*)—Definition of Sewer and Drain—The Discharge of the Niagara River—Errata in Article on the Discharge of the Niagara River.
CONSTRUCTION NEWS.....238, 240
Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous.
INDUSTRIAL NOTES..... 240

The annual cost of maintenance of main highways in the county of Hampshire, England, averaged for the nine years ending March 25, 1889, the sum of $125.97 per mile. The total mileage in the county was 382 miles in 1880, and 532 miles in 1889. The proportion in 1889 was 490 miles in the rural districts and 41 miles in urban districts. The average cost of maintenance of the former in 1889 was $97.80 per mile, and of the latter $531.77. Besides the main highways there are in the county about 3,100 miles of rural roads, maintained at an expenditure of about $100,000 per annum, and about 210 miles of urban district roads, on which some $65,600 is expended, or an average per mile of $32.30 and $312.40, respectively.

The iron and steel industries of the Southern states are summarized as follows in Census Bulletin No. 347, in comparison with the census return for 1880:

	Blast furnaces.		Mills and steel works.	
	1880.	1890.	1880.	1890.
Number of	121	90	48	49
Capital invested	$16,964,207	$33,207,370	$11,665,260	$17,528,006
Hands employed	9,486	7,932	10,615	16,696
Wages paid	$2,186,855	$2,917,158	$3,964,612	$4,677,185
Cost of materials	$4,452,864	$15,410,982	$10,252,098	$13,066,029
Value of product	$7,769,050	$22,404,870	$17,062,587	$19,920,952
Tons of product	350,436	1,834,588	290,324	515,775

In the above the item for hands employed in blast furnaces, for 1890, excludes officers, clerks, salesmen and their salaries. The decline in price of products accounts for the apparently small increase in value of products for 1890, as compared with the great increase in output. The hands employed in 1880 included those engaged in mining; these are included in 1890. This statement is given by the Census Bureau with the caution that owing to the manner in which the census of 1880 was taken, there is some duplication in the cost of production, and a true comparison with the more detailed census of 1890 is impossible.

The railway safety appliance bill was signed by President Harrison on March 3, and the pen with which he signed it was presented to Mr. Edward A. Mosely, Secretary of the Interstate Commerce Commission.

The Massachusetts Highway Association has been organized, with Mr. W. E. McClintock, President, and C. R. Cutter, Secretary. The purpose of the Association is to extend acquaintance among members, present papers and discuss progress and to visit different fields of work. The proceedings are to be published. The charter members include some of the most progressive road engineers of the state. President McClintock is at the head of the road engineering department of the Lawrence Scientific School, of Harvard College, and is a prominent member of the Massachusetts State Highway Commission.

Grade crossings in Jersey City over the tracks of the New York, Lake Erie & Western R. R. must be removed according to an ordinance passed by the Street and Water Board. Plans for the elevation of the tracks have been prepared by Chief Engineer A. Mordecai, chief engineer of the railway, for submission to the Board at its meeting on March 9.

The most serious railway accident of the week was the derailment of a passenger train on the St. Louis & Iron Mountain R. R., near Hope, Ark., March 1. The accident is attributed to a broken rail or spreading of the track. The mail car, express car, chair car, two day cars and a sleeping car were thrown from the track, and went down the bank. The chair car, the two day cars and the sleeper were set on fire by overturned heaters and destroyed. The baggage and mail cars were partly burned, but their contents were saved. The engine did not leave the track, and was run to Hope for assistance. About twenty-five persons were injured, some seriously, and at least one fatally.

A locomotive boiler explosion occurred at McKune's, Pa., on the Lehigh Valley R. R., March 3, killing one man and fatally injuring three others. The engine was hauling a train at the time.—Another locomotive boiler explosion occurred March 5, at East Hagerstown, Md., on the Western Maryland R. R., injuring three men, one of them fatally. The engine also was hauling a freight train at the time.

In the investigation of the disaster caused by the fall of the walls of the burned York Building, at Chicago, noted in our issue of March 2, the coroner's jury charged four men with criminal negligence, and recommended that they be held to await the further action of the grand jury, as follows: M. Campbell, contractor and builder; C. J. Furst, architect; Louis O'Neill, building commissioner, and John York, owner of the building.

A bridge on the Chicago & Erie R. R., crossing the Ottawa River near Lima, O., is said to have given way under a freight train March 6, throwing 19 cars into the river.

A water-works stand-pipe at Marysville, Mo., fell on Feb. 28. The structure was 18½ ft. in diameter and 135 ft. high, and, as reported, was nearly full of water and ice at the time of the failure.

A bridge failure, caused by a derailed train occurred at Glencoe, Pa., on the Baltimore & Ohio R. R., Feb. 18, and we are indebted to Mr. C. C. Ewell, Engineer of Maintenance of Way of the Pittsburg Division, for the following particulars of the accident. The bridge was an iron through truss structure of 104 ft. span with three panels, but carried no load, being supported by wooden trestles carried by two wooden piers. The piers carried three trussed stringers, 8 × 18 ins., under each rail. The bridge was built by the Phoenix Bridge Co. about 1871, and the wooden supports were three years old. The accident was caused entirely by a car becoming derailed at the end of the bridge by a broken axle. The iron work was completely demolished, and one side of the middle span of the trestle work was broken. Four cars were completely destroyed, being piled up in the creek. They were in the middle of a long freight train. The train was moving very slowly at the time, as it was approaching a block signal; otherwise the accident would have been much more serious. Nobody was killed or injured.

An accident occurred in the erection of the 65d-St. extension of the Chicago & South Side elevated railway, Feb. 28, by which two men were hurt. The timber trestle which carries the erecting derrick had been carried forward for another bent, and the engine and derrick were moved upon it before the trestle was completed, and the posts spread, letting the engine and derrick fall to the ground. The contractors for the erection are McCain & Co., of Chicago, and the accident is said to have been due to carelessness on the part of the workmen.

The Pennsylvania R. R. Co. ran 53 trains into Washington in 12 hours, on March 3 and 4. The average was about 10 cars to each train, representing over 26,000 passengers. The Baltimore & Ohio R. R., in the same period, ran 24 trains and about 12,000 passengers into Washington. No mishap of any kind occurred on either line.

A survey for a railway from Vancouver to Behring Straits is reported as completed by a party under Mr. Robert Faulkner, acting for certain New York capitalists. The survey has been made from Vancouver, B. C., to Cape Prince of Wales, the point of Alaska nearest to Asia. The whole distance is 2,346 miles and the route is reported as feasible, with some difficult work in crossing the Alaskan range. The cost of the road is estimated at an average sum of $23,000 per mile. The survey was commenced on June 3, 1891, and was finished in September, 1892. Behring Straits at the point struck by the line is said to be 26½ miles wide with eight islands cutting this distance. The report says that all of these passages, except two, can be spanned by cantilever bridges; for the two steam ferries or pontoons would have to be used. The foundation soil is reported as good and free from quicksands, and all icebergs of any size ground 40 miles above. The distance from East Cape, on the Asiatic side, to Sandeluske, on the proposed Siberian railway, is 2,275 miles, while the names of Henry Clews, Drexel, Morgan & Co. and I. C. Seibert, a banker of St. Petersburg, are mentioned. No further details of purpose, expectations or resources are made public.

Messrs. Joseph H. Cofrode and William F. Harrity, appointed by the Court receivers for the late firm of Cofrode & Saylor, bridge builders of Philadelphia, are given full power to continue the said business, and will do so. We understand that there is an abundance of work already in hand and the many friends of the firm expect it to emerge soon from its present embarrassment.

A steel arch bridge of 336 ft. span and 100 ft. rise is to be erected over a gorge in the Rocky Mts., on the line of the Canadian Pacific Ry. The total length of the bridge will be 465 ft., and its height above the bottom of the gorge will be between 275 ft. and 300 ft. There will be 1,400,000 lbs. of metal in the structure. The arch is to be built after designs by Chief Engineer P. A. Peterson, of the Canadian Pacific Ry., and the contractors are the Hamilton Bridge Co., of Hamilton, Ont.

Incandescent lamp litigation is still the uppermost topic in electrical circles. The opinion of the court in the decision announced in our last issue, granting an injunction against the Beacon Co., incandescent lamp manufacturers, leaves the higher courts to determine whether Henry Goebel really invented the incandescent lamp before Edison. Judge Colt in his opinion held that while there appeared to be little doubt that Goebel did more or less experimenting in lamp manufacture at an early date, the evidence was not sufficient to overthrow the great inherent improbability that his work was mere experimenting, and did not attain that degree of success that entitled it to rank as a completed invention. In the litigation between the Edison and Westinghouse companies, the question now at issue is whether the new lamp of the Westinghouse infringes the Edison patent. Decision of this question by a preliminary injunction has been refused, the court holding that expert testimony must be taken on the case in the usual manner.

The Serve ribbed steel boiler tubes are to be used on the new steamer being built for the Fall River Line, running on Long Island Sound (Eng. News, Feb. 23) which is intended to eclipse in size, speed and in the elegance of the appointments any steamer of the class hitherto built. The Serve tube was illustrated and particulars of tests were given in our issue of May 9, 1891. The engines and boilers are being built by the W. & A. Fletcher Co., of Hobocken, N. J., and this firm has ordered from Chas. W. Whitney, 81 Fulton St., New York, 1,840 of the Serve ribbed steel tubes 10 ft. 3½ ins. long and 3½ ins. diameter. The steamer is to have ten boilers of the Scotch marine type, 14 ft. diameter and 14 ft. 6 ins. long, each boiler to be fitted with 184 of the Serve tubes. With plain tubes the consumption of fuel was estimated at 100 tons per round trip between New York and Fall River, and the saving in fuel or increased steaming capacity by the use of the ribbed tubes is estimated to be at least 10%, and more than this under favorable conditions. By this estimate, and at the present cost of anthracite coal in New York, $4.30 per ton in the bunkers, it is claimed that the ribbed tubes will pay for themselves outright in two years' service, and then make half their cost every year for the owners of the boat during the balance of their lives, which is estimated at five years, the total life of the tube under usual conditions in marine boilers averaging seven years.

The naval appropriation bill for the coming fiscal year has been passed, with $21,234,000 set aside for this purpose. Under the head of "increase of the navy", the sum of $6,900,000 has been appropriated, but this includes no allowance for armor-plate.

60,000-LB. HOPPER-BOTTOM COAL CAR; CHICAGO, BURLINGTON & QUINCY R. R.

There are two classes of coal cars in general use in railway service, one of which is the drop-bottom, or hopper-bottom, car, discharging its load through the floor; and the older being the ordinary flat-bottom car, unloaded by shoveling. The small, old-fashioned, four-wheel and six-wheel cars are still used to a limited extend on some of the coal roads, but are going out of use, as they are very hard on the track, and cause frequent derailments, owing to the tendency of the middle cars of a train to jump the track when the engine brake is applied, and the rear cars crowd up against those in the middle of the train. There are also special forms of coal cars in use on certain roads, including the iron hopper cars on the Baltimore & Ohio R. R., but the bulk of the coal traffic is carried by long cars of the hopper-bottom or flat-bottom class, with four-wheel trucks. In the most recent practice these coal cars are fitted with automatic M. C. B. couplers and the Westinghouse train brake.

There is a distinction between drop-bottom and hopper-bottom cars, which, however, is little observed, the terms being generally used as synonymous. Properly a drop-bottom car has no hopper, but the doors close flush with the flat floor; while a hopper-bottom car has the doors at the bottom of a discharge hopper, as in the car illustrated herewith.

We illustrate this week the standard 60,000-lb. hopper-bottom coal car of the Chicago, Burlington & Quincy R. R., for the drawings of which we are indebted to Mr. G. W. Rhodes, Superintendent of Motive Power. In our issue of Aug. 11, 1892, we illustrated and described the standard 50,000-lb. coal car of the Chicago, Rock Island & Pacific Ry., which is of the second, or flat-bottom, class. The former car is the shorter, but gets its greater carrying capacity by its increased height of sides, 4 ft. 7 ins., instead of 3 ft. 3 ins., as in the latter car. The high sides are prevented from bulging by horizontal truss rods. The following table gives the dimensions, etc., of the two cars.

	Hopp. Bottom, C., B. & Q.	Flat Bottom, C., R. I. & P.
Length over end sills..	30 ft. 0 ins.	36 ft. 0 ins.
" over body.....	28 " 0 "	33 " 10 "
" inside..	27 " 5 "	33 " 4½ "
Width over side sills..	8 " 6 "	8 " 6 "
" " end sills..	9 " 0 "	9 " 0 "
" " body.	8 " 6 "	8 " 6 "
" inside.....	8 " 0½ "	8 " 0½ "
Ht., rail to c. of coupler	2 " 10 "	2 " 10 "
" rail to top of body.	8 " 0 "	6 " 8 "
" inside.	4 " 7 "	3 " 3 "
Wheel base, truck.....	5 " 0 "	5 " 0 "
" " total.....	25 " 0 "	30 " 10 "
Dist. c. to c. of trucks..	20 " 0 "	25 " 10 "
Weight of body.....	12,000 lbs.	15,080 lbs.
" of two trucks....	12,000 "	11,520 "
" total.....	24,000 "	26,600 "
Capacity.	60,000 "	50,000 "
Number in service.....	200	300
Approx. cost.....	$493	$475

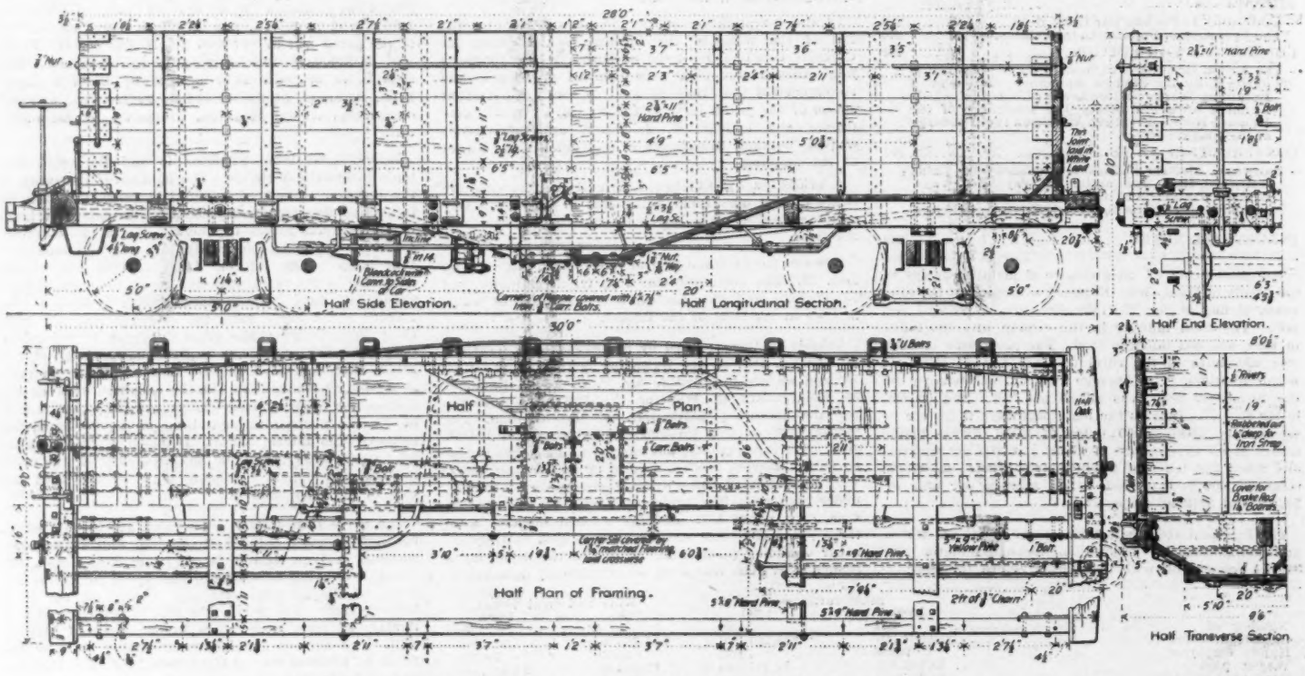
The trucks are the company's standard pattern for freight service, as illustrated in our issue of Feb. 23. They have diamond frames, rigid composite bolsters, and spring hangers instead of the usual spring planks. The wheels are of cast iron, 2 ft. 9 ins. diameter, with a truck-wheel base of 5 ft. They are carried on collarless axles, 6 ft. 11 ins. long, with journals 4¼ × 8 ins.

There are in service only about 200 of these cars, which were built for the use of the Burlington & Missouri River R. R., in Wyoming (a part of the C., B. & Q. R. R. system). A few were built at the C., B. & Q. R. R. shops, but the majority were built by a contracting company. Mr. George F. Wilson, Superintendent of Motive Power and Equipment of the Chicago, Rock Island & Pacific Ry., informs us that all the coal cars of his road, of the class referred to above, have been built by contract work.

The sides and ends are of hard pine planks, 2¾ × 11 ins., secured to outside stakes of oak, the stakes being 3½ × 3 ins. at the top and 3½ × 5 ins. at the bottom, where they are set into the stake pockets. An iron strap, ¼ × 2½ ins., is attached to the top of the sides by lag screws. The floor is of 1¾-in. planks, tongued and grooved, and is flat at the ends, so that some shoveling is required to pass the coal to the hopper, although in some hopper-bottom cars the floor has a continuous slope.

The hopper has a slope from the sides as well as the ends, and has double doors operated by a chain on a shaft placed just above the sills. The hopper opening is about 5 ft. wide and 2 ft. 8 ins. long. The body bolster is of iron, with pressed steel center plate, and is similar to the company's standard pattern for stock, box and furniture cars of 50,000 lbs. and 60,000 lbs. capacity (Eng. News, Feb. 23, 1893). The general construction of these cars is similar to that of the coal cars 34 ft. 9 ins. long, of the same road.

The draft rigging is placed between the center sills and attached to them, the drawbar passing through the end sill, as in the 50,000-lb. furniture car of the C., B. & Q. R. R., described and illustrated in our issue of Feb. 23. In another column the question of uniformity in freight car draft gear is editorially discussed. The bottoms of the sills are 2 ft. 6 ins. above the rail. The M. C. B. type of automatic coupler is used, with a rod and handle for uncoupling from the outside of the car. A deadblock 4½ ins. wide and 1 ft. 10 ins. long, faced with ½-in. iron, is above the drawhead and bolted to the end sill. The cars are fitted with the Westinghouse automatic brake, and with a Christie brake shoe on the inner side of each wheel. The brake cylinder is placed near the center line of the car, close to the hopper, and the train pipe is carried along the edge of the hopper, as shown. The brakes can also be operated by hand, and at the hand-brake end of the car there is a platform 12 ins. wide.



60,000-LB. HOPPER-BOTTOM COAL CAR; CHICAGO, BURLINGTON & QUINCY R. R.

SEWAGE PURIFICATION IN AMERICA.

(With inset.)

(Continued from p. 186.)

Hastings, Neb.

The following description of the sewage purification plant at Hastings, Neb., where intermittent filtration has been practiced for two years and, as designed, will be combined with sewage farming, was prepared for us by the engineer of the sewerage and sewage disposal systems, Mr. J. M. Wilson, of Omaha, Neb.:

Hastings, Neb., is a thriving young city of some 15,000 (13,584 in 1890) inhabitants, situated on the plateau between the Platte River and the Republican. The Platte, about 16 miles to the north, is a broad, shallow stream, carrying in the spring and early summer a large volume of water from the melting snows in the mountains of Colorado and Wyoming; but in the late summer and winter the stream is largely lost in the sands of its many broad channels.

The Blue, a tributary of the Kansas River, about ten miles to the south, is a much smaller stream, but, being confined to a narrower channel, is more permanent in its flow.

These were the nearest and the only streams that

could possibly be used for the discharge of sewage. Higher lands to the north cut off the outlet to the Platte. To reach the Blue would require that the line should follow the windings of some of the draws or valleys leading from the vicinity of Hastings to that river. This would so lengthen the line and increase the cost that all thought of reaching a running stream with the sewage was abandoned.

The only available method of disposal was a sewage farm. Upon investigation, the conditions at Hastings were found to be very favorable for the success of such a plant. Below the surface no water is found until a depth of about 100 ft. is reached, at which depth permanent water is found in sand and gravel. The subsoil here is quite pervious to moisture; after the heaviest rains the water disappears quickly from the surface, being absorbed by the 100 ft. or more of porous subsoil, without producing that condition of complete saturation which is so often found where the underlying strata are impervious or the permanent water level is near the surface.

In many cases in the lands which must, of necessity, be selected for sewage farms, these favorable conditions do not exist, and only a few feet of the upper strata can be made available by artificial drainage. The amount of sewage that such lands will absorb without saturation is, of course, very limited, and the condition of permanent moisture so near the surface gives, by capillary attraction, all the moisture, in most cases, that crops grown on the land can appropriate. The additional moisture supplied by the sewage is just so much excess. The result is that on most sewage farms where crops are raised, very little of the sewage is applied to the crops, or only such crops are raised as will endure excessive moisture. The profitable crops that will endure such conditions are very few indeed. On the contrary, in this plains region, with its great depth of porous subsoil and its moderate rainfall, the conditions for disposing of sewage successfully, either by discharging it intermittently on limited areas or by applying it to crops, were peculiarly favorable.

The general surface of this part of Nebraska is a gently undulating plain, rising to the westward at the rate of say, 7 to 10 ft. per mile. In the vicinity of Hastings the rate is 9 ft. per mile. The plain is broken by draws or valleys, down which the water passes to the permanent streams when there is any surplus. After heavy rains the draws are, for a few hours, quite respectable creeks; but ordinarily they are dry, and the surface where it has not been disturbed by the plow, is covered with a thick, strong sod. Along the sides of these draws the land has been lowered by the action of the water considerably below the general level of the surrounding plain, and yet left high enough above the bottom of the draw to insure adequate drainage.

With a pumping plant that would raise the sewage 15 ft., any one of the many smooth farms lying to the east was available for a sewage farm, practically graded and ready for the reception of the sewage. The objections to this arrangement were: (1) The cost of erecting and maintaining the pumping plan, and (2) the difficulty that might arise in draining such a tract in case, as was likely, it should need drainage after the sewage was applied.

If the sewage was to be disposed of by gravity the only available fields were the lands before mentioned, lying adjacent to the draws. These were somewhat irregular in outline and elevation, and would require considerable grading to put them in shape for the application of the sewage; but they were so situated that good surface drainage was insured, and if it should become necessary to tile the farm later, the draw would afford a ready outlet for such drainage.

A small draw heading in the northeast corner of the city leads off toward the northeast about 1½ miles, where it intersects with a much larger draw from the northwest. Along the borders of this larger draw there are considerable areas which, while elevated enough above the bottom of the draws for drainage, are low enough to make it possible by careful economy in grades to reach them by gravity from every part of the city. It was found that the storm water could be sent off through the natural waterways by using short runs of large pipe at moderate depths, and with better fall than it was possible to secure for the sewer line to the farm.

This, with the limited areas available for receiving the sewage, and the difficulty of taking care of the storm water on such a farm, settled the question in favor of the separate system of sewage.

After a careful study of the established grades for the streets, with the necessary additional levels taken, main lines were laid out, centering toward and in the northeast corner of the city, where all were collected into one 18-in. main leading to the farm. The minimum grades adopted were as follows:

For 18-in. pipe, 18-100 per 100 ft.

For 15-in. pipe, 2-10 per 100 ft.

For 12-in. pipe, 2-10 per 100 ft., some of it finally being laid to a grade of 26-100 per 100 ft. and some 3-10 per 100 ft.

For 8-in. pipe the minimum grade was 5-10 per 100 ft.; on all curves the rates were doubled, and all junctions except house junctions were made in manholes; and where any pipe connected through a manhole with a larger pipe, the crown of the small pipe was set on the same level with the crown of the larger.

Grade stakes were set every 25 ft. in the bottom of the trench for the flow line of the sewer. The earth was then removed to a depth sufficient to allow for the thickness of the pipe, the bottom of the trench being rounded to fit the pipe approximately. A strong, light cord was then stretched tightly between each two adjacent grade stakes, and another stake was driven half way between, so that the cord, when drawn tight, just touched the top of the intermediate stake. As the grades used were very light, as a check on the level work and in the driving of these intermediates, a straight edge 13 ft. long, with a sensitive bubble for leveling was provided, the inspector on the work applying this to the stakes in order, just ahead of the pipe laying. The pipe was laid to grade by means of the straight edge, resting at one end on the flow line of the pipe already laid, and at the other on the nearest grade peg, the flow line of each pipe being made to coincide with the straight edge throughout. The workmen made some objection to this method at the beginning, thinking it less rapid than other means that might have been used; but later, when the work was on better grades, and the risk not so great, and permission was given to use other methods, after a trial, the pipe gangs all returned to the use of the straight edge, as the most rapid and satisfactory. However, this could hardly be considered conclusive as to the comparative merits of the methods, as the men were all thoroughly broken in and understood how to work with the straight edge before we reached any work on which I was willing to risk any other.

The nearest land available for a disposal area was a tract of 70 acres, somewhat broken. To find smoother land upon which the sewage could be deposited by gravity would have necessitated a lengthening of the main pipe from 3,000 to 5,000 ft., and the crossing of several small draws. The additional cost of this part of the line would have more than overbalanced the necessary expense of grading, not to mention the extra cost of caring for and maintaining the additional line.

The 70-acre tract selected for the sewer farm is shown by Fig. 72, on the inset. The southwest part of the tract is too much elevated to receive sewage, but is valuable farming land, and will furnish a desirable building site for the residence of a superintendent.

The northwest portion of the area north of the draw is very rough and cannot be utilized for sewage, except at heavy expense for grading and piping. The central part of the western half of the area has been graded into areas, as shown on the map, Fig. 72, each having its own level and separated from the adjacent areas by a low ridge of earth. The cross section at the foot of Fig. 72 shows the arrangement of these ridges and slopes. The elevations selected and the forms of these areas were determined largely by the question of economy in moving the earth.

These areas were brought to a uniform grade, except at the points where the sewage is received from the distributing gutters. Here the surface was slightly elevated to secure a better distribution over the surface when the sewage is first discharged on an area. The sewage is discharged first into a settling tank, shown in plan and section by Fig. 73.

This tank is provided with cast iron gates for controlling the flow of the sewage. It was the intention to provide a screen, but it was found that it was not necessary, as the paper and the small amount of solids which would make trouble by clogging the drains were all deposited in the lower part of this tank, from which it could be drawn off on the lower area, No. 8, Fig. 72, where it could be readily collected and disposed of when the water was drained out of it.

From this settling tank the sewage is conducted to distributing or outlet gutters so situated as to distribute the sewage on two or more adjacent areas. These gutters are built of brick laid in cement mortar and plastered with Portland cement, as shown by Figs. 74 and 75. The gates which regulate the flow are of 3-16-in. plate iron, faced with sole leather and set at an angle from the vertical, so that their weight, which is increased by a heavy cast iron disk bolted to the back, acts with the sewage to shut the gate snugly against the seat. The seating face is 2 ins. wide and built up of cement. The gate is opened by revolving it upward and backward till it rests on the top of the gutter, as shown in Fig. 74.

Areas Nos. 1 and 8 receive sewage from short lines of pipe leading from the settling tank, as shown by Figs. 72 and 73. Areas Nos. 2, 3, 4 and 5 are supplied by an 18-in. pipe from the settling tank, the sewage being distributed to each of the four beds by the four-way gutters shown in Fig. 74. A 12-in. continuation of the 18-in. pipe from the settling tank carries the sewage to areas Nos. 6 and 7, the two-way outlet gutter here being similar to that shown in Fig. 75. An ordinary wooden sluice gate is the only means provided for supplying sewage to area No. 9. This gate is shown in plan and section by Fig. 76. Area No. 10 is supplied by one of the branches of the two-way gutter shown in Fig. 75. The other branch of this two-way gutter is designed to discharge sewage onto a part of the irrigable land nearest to the distributing basin, the remaining part of this section being provided for by the 8 and 12-in. outlets on the south side of the basin, all as shown in the plan, Fig. 72. The 18-in. main outlet is extended across the draw to the most distant part of the disposal area, this section being suitable for irrigation.

The farm is under the care of a superintendent of sewers and water-works. He visits the farm once a day, or as often as may be necessary to change the flow from one area to another. The time of discharge on any given area is determined largely by the season and the amount of rainfall, and must be regulated by the experience and intelligence of the superintendent. Occasionally the areas are plowed to facilitate absorption and to cover up deposits, which, with the carting away at intervals of the sludge discharged from the settling tank, is all the attention the farm receives.

Of course, with further development of the system, more time must be given to it. The works have now been in operation about two years. The first year was an unusually wet season, and the capacity of the soil for receiving sewage was for this reason much reduced, but it was all discharged in rotation upon the areas that had been graded. No offensive odors were perceptible from the fields, as everything was distributed before decomposition set in, and the sewage was not allowed to discharge or remain on one area long enough to become putrid. The only time when any odor is perceived is when the settling tank is opened to discharge the collected solid matter. At such times for a short interval there is a little odor when the discharge is first made; but it is only perceived in its immediate proximity.

Up to Jan. 1, 1893, the number of sewer connections that had been made was 119, mostly from the business part of the city and the larger residences. Outside of the business portion no attempt has been made to compel the making of connections. Other areas will need to be added as the use of the sewers becomes more general.

The lands marked on Fig. 72 as suitable for irrigation cultivation are all available for absorption fields; and if a larger area is needed, the lands along the valley to the eastward will afford opportunity for increasing the areas to any extent desired. By means of shallow ditches and furrows along the slopes the sewage may be conducted over these lands and used for irrigating crops, as with the water from irrigating canals in the arid

regions of the West. No attempt, as yet, has been made to use it in this way, but at intervals the sewage is allowed to flow over the meadow land of this portion as far as it can do so without special direction and yet not escape into the draw.

The drainage or absorption areas now in use are not underdrained, but depend entirely upon the capacity of their soil for absorption. Ultimately tiling will be necessary, and this will convert them into filtering beds discharging their effluent into the draw. When the farm was first put in use it had been freshly graded, and it was not thought best to put in tile until all settlement of the fills had ceased. We also wished to test the capacity of these areas without the tiling. With the amount of sewage now disposed of the results are satisfactory, but I have no doubt that in time they will all require drainage.

In arranging this farm, while keeping in view the desirability and the possibility of using the sewage in the cultivation of crops and arranging for its use when the quantity of sewage would make such use profitable, these two facts have been kept steadily in mind: (1) That with all crops of value the amount of sewage that can be used with profit has very definite limits; (2) that the time during which it can be applied to any crop is ordinarily confined to only a limited portion of the growing season. To apply in greater quantities and at other times is to ruin the crop.

Hastings is a typical town of the Western plains, and suggests a solution of the sanitary problem that confronts a great many of these towns, by reason of their level areas and remoteness from streams of such magnitude that sewage may be safely discharged into them.

In addition to the above information from Mr. Wilson, Mr. G. W. Woodward, City Engineer of Hastings, writes us that the disposal area is about 1½ miles from the city; that each of the filtration areas is about two acres in extent, and receives sewage for a day or two at a time, with a rest until the sewage has been applied in succession to the other areas; and that the application of sewage to the land creates no nuisance, and causes but very little odor. Mr. Woodward states that he was city engineer when the sewerage system was built, and acted as constructing engineer, with Mr. Wilson as chief engineer.

Two of the seven Harveyizing furnaces erected by the Bethlehem Iron Co. for the U. S. Navy Department were completed on Feb. 20. The remaining five will be in operation by June 1 next.

The new Morgan Line steel steamship "El Rio," built by the Newport News Shipbuilding Co., from the designs of Mr. Horace See, is now in New York preparing for her first trip to New Orleans. This ship is 406 ft. long, 48 ft. beam, 33.9 ft. deep from upper deck to top of keel, and has a displacement of 4,500 tons. She is to be driven at a 16-knot speed by a vertical, inverted, triple-expansion engine, with 32, 52 and 84-in. cylinders and 54-in. stroke, at 167 lbs. steam pressure. Her loaded draft is 23 ft. and she can carry 13,000 bales of cotton. This steamship, and a sister ship now building at the same yard, will be used solely as freight steamers between New York and New Orleans.

Brick paving has been laid in the city of South Bend, Ind., on a foundation of well-rolled gravel, and is stated by the city engineer, Mr. W. M. Whitten, in a letter to "Paving and Municipal Engineering," to be in as good or better surface after a year's traffic as the brick paving in other cities laid on a concrete foundation. He also states that a street in South Bend paved with one course of brick is in better surface than one paved with two courses at a cost 30% in excess. Mr. Whitten lays all brick pavements with the courses at an angle of 45° with the course of the street, and believes that the pavement wears more evenly and keeps in better surface when so laid.

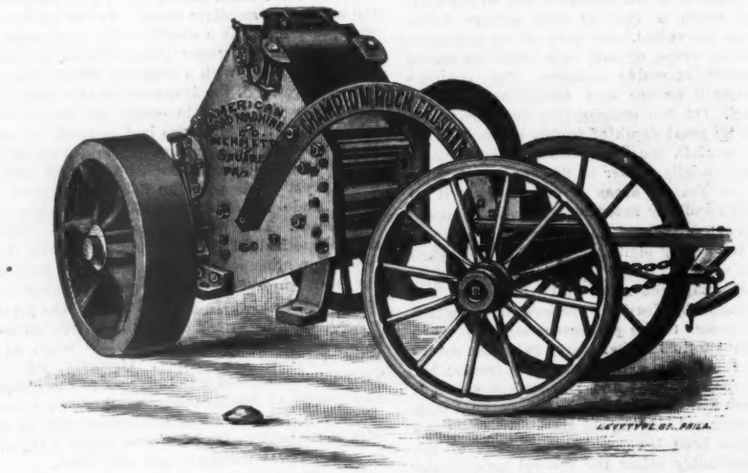
The Columbia River, from the International boundary to Rock Island Rapids, is 294 miles long, says Captain Symons, U. S. Engineer, in his report to the Chief of Engineers, General Casey. This river has an average fall of about 2½ ft. per mile; a low-water discharge of 50,000 cu. ft. and a high water discharge of 300,000 cu. ft. per second. The average velocity is 3½ miles per hour, though in many places this increases to 8, 12 and even 15 miles per hour. As far as ascertained, there is generally ample depth for navigation. Captain Symons thinks this length of the river is worthy of improvement to a certain extent; though he does not believe it can soon become a through highway of commerce, as hoped for by some.

THE CHAMPION STEEL ROCK CRUSHER.

The American Road Machine Co., of Kennett Square, Pa., is putting on the market a portable rock crusher of the reciprocating type, designed especially for the use of small townships and highway contractors, and enabling rock to be crushed close to the place where it is wanted for use, thus saving expense of transportation. Two sizes of the crusher are at present offered, one turning out 9 to 13 cu. yds. per hour and weighing about 8,000 lbs., the other having about 7 to 11 cu. yds. capacity and weighing about 5,000 lbs. About 12 and 10 HP. is required to drive the two sizes, respectively.

The machine is raised on skids when at work; for transportation it is raised from the skids, and two bent irons are bolted to the front end carrying its weight to the front wheels of an ordinary farm wagon. The flywheels of the crusher form the rear traveling wheels when the machine is moved. It is stated that the time required to take down and set up crusher, elevator and revolving screen does not exceed four hours. This feature is a most valuable one to contractors. In road construction, for example, in a country where good rock is abundant, the crusher may be moved at frequent intervals, and the cost of transportation of the macadam from the crusher to the place of use may be greatly reduced. Masonry contractors, too, ought to be able to considerably reduce the cost of concrete by setting up a crusher close to the site of their work, and using rock excavated on the site or quarried in the immediate vicinity.

The makers of the crusher state that they have made a gain in lightness without loss of strength by substituting steel for iron castings for the frame of the machine and the principal working parts. Chilled castings are used for the parts subjected to greatest wear. The main shaft runs in phosphor-bronze bearings. Power is transmitted from this shaft to the crushing jaw by a double cam on the shaft, giving two strokes of the jaw for each revolution. The strain is transmitted from the cam to the jaw through an intermediate lever or tumbler, which considerably increases the effective pressure of the cam.



CHAMPION ROCK CRUSHER.

THE WATER FILTRATION PLANT AT LEEUWARDEN, HOLLAND.

(With inset.)

The filtration plant of the city of Leeuwarden is of special interest because of the appliances used to regulate the rate of filtration. The city has a population of about 30,000, and an average daily water consumption of 475,000 gallons, or 15.8 gallons per capita.

The water supply is derived from a small lake some distance from the city. The water thus obtained is yellowish in color and somewhat brackish in taste. The conduit empties into a suction chamber, located between the two pumps in the engine house. The air is extracted from the chamber as much as necessary by the condenser, so that the water can enter from the conduit with constant velocity. There are two compound pumping engines, each with a capacity of 475,000 gallons per day. After passing through combined precipitation and settling basins, filter beds and a clear water basin, the water is forced by high-pressure pumps through 11.2 miles of 9.85-in. pipe to a 132,000-gallon water tower.

There are four settling basins, each with a clear water capacity of about 238,000 gallons, designed for consecutive use. The bottom and sides of the basin consist of puddled homogeneous clay, on top of which are two layers of flat cobble stones, laid in Portland cement.

The portion of the settling basins beneath the low-water mark, shown in the section Fig. 1, on the accompanying inset sheet, has a capacity of about 119,000 gallons, and is designed to receive the sediment. A drain pipe is provided for the removal of the sediment.

Before entering the settling basins the water is aerated by passing over a series of steps and receives a solution of 1 part of alum to 6 of water, mixed in 3,640-gallon tanks, forced into the pipes supplying the basins by small pumps, whose discharge is maintained at a constant proportion to that of the main pumps, their stroke being the same as the latter. The actual proportion of alum solution to total water pumped is regulated by a valve connected with the delivery pipe from the alum pumps, to which is fitted an indicator showing the size of the valve opening.

Water is drawn from the settling basins by means of a pipe, the first length of which is pivoted, as shown in Fig. 1. The intake pipe connects with a stand-pipe, in which is a partition weir designed to prevent the dirty water in the lower part of the settling basins from passing to the filter beds. A float is used to keep the outer end of the intake pipe at a constant distance below the water level. This, with the seat for the float, is also shown by Fig. 1.

The water enters the filter beds through a well, Fig. 1, over the upper edge of which it flows down a tiled gravel slope. The bottom and sides of the filter beds are of materials similar to those of the settling basins.

The filtering materials, beginning at the top, consist of 7.9 ins. of fine dune sand, 7.9 ins. of coarse river sand, 3.95 ins. of sea shells, 3.95 ins. of fine gravel, and from 3.95 to 7.9 ins. of coarse gravel. The three beds are square, with an area of 747 sq. yds. each. The rate of filtration is 2.36 ins. per hour. The filtered water is collected by means of 3.15-in. pipe, with open joints, which lead to a 5.9-in. central drain.

To maintain a constant depth of water upon the filter beds there is used a rubber-covered wooden stopper valve, attached to the weighted arm of a lever having a float on the other arm, all as shown at the left of Fig. 1. By moving the counterweight to the right or left the float on the other arm of the lever is raised or lowered, and with it the depth of water is increased or decreased, as desired. To avoid trouble with ice, it is suggested that the device be modified by placing the float directly

over the stopper, where the flow of water from the inlet pipe would prevent the formation of ice.

The rate of filtration is controlled by the regulating weir shown in Fig. 2. Water enters the regulating chamber through a pipe from the filter bed and passes through a weir to a second compartment, and thence to the clear water basin shown at the left. The rate of flow through the weir is diminished or increased by raising or lowering the gate by means of a rack and pinion. This latter operation raises or lowers the indicator on the larger of the two dials shown by section CD, Fig. 2, and shows the height of the top of the weir. The height of the water flowing over the weir is shown by the smaller of the two dials, through the agency of the float valve in the receiving chamber. The engineer in charge of construction was H. P. N. Halbertsma, of Hague, Holland.

We are indebted to the "Journal fuer Gasbeleuchtung und Wasserversorgung" for the information and illustrations given.

THE CRANE FIRE-HYDRANT.

The fire-hydrants here illustrated are claimed to be the results of an extensive inquiry into the experience and requirements of operators of waterworks in the United States, and these patterns have been adopted with the belief that they meet the requirements, as explained below.

The compression hydrant, Fig. 1, is of a well known type in which the main valves are leather-

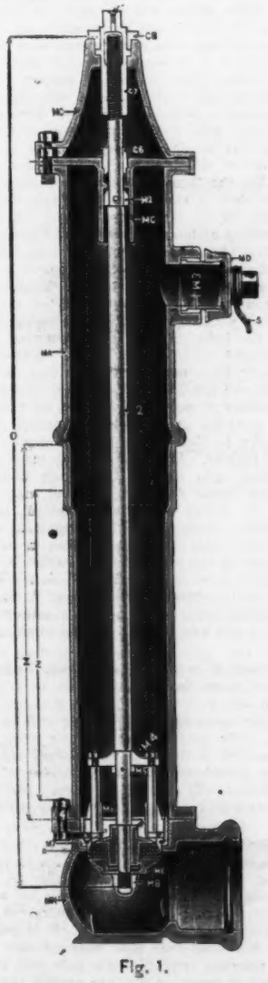


Fig. 1.

faced and closed by the pressure in the water-main. This type is now used in nearly all large cities, and meets with general satisfaction. The leather facing permits very rough usage, and in the standard here illustrated the aim has been to aid materially in its operation, reduce the liability to damage, and make it easy to repair when injured by unskillful handling. To this end the valve and seat are so made that a broken stand-pipe can be renewed without shutting off the water, as the valve-seat is in the base and held in place by the pressure. (2) In closing the valve the strain of a torsional nature comes on a hexagon nut fastened to the rod under the stuffing-box, and should this be torn loose by careless handling, no further damage can follow, as the drip-yoke is loosely collared on, and allows the stem to turn. (3) The water-valve is made of solid brass; is positive in action; has no faces of leather to wear, and no interme-

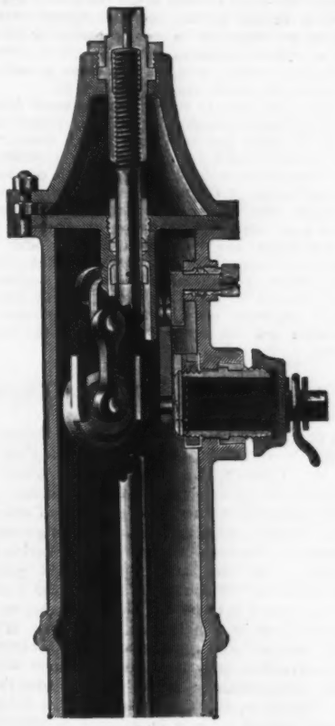


Fig. 2.

diate mechanism to get out of order It cannot be clogged by sediment floating into the waste-holes. The waste itself is brass or brass-lined, and is double and provided with three waste holes. It is claimed that it will drain in one-half the time required by the ordinary type of hydrant. (4) Should all the water that is left between the valve and the waste-holes be frozen solid, the hydrant will still operate, as the interior of the valve is not interfered with; the ice is broken at the first turn of the stem-nut. (5) In case of repairs, the valve and seat can be unscrewed from the base by a special wrench and pulled through the barrel, after the tap is taken off. The same wrench serves as a key to shut off the water from the mains, so no extra tools are required.

The independent nozzle shut-off, Fig. 2, is designed to meet a growing demand for hydrants provided with independent gates at each nozzle, so that additional lines of hose may be attached to the hydrant without shutting off the water from those already in use. It is simply a sliding gate closing each nozzle, and each is lifted independently by the manipulation of a crank-nut placed above the nozzle. The valve is simple and self-adjusting, and when lifted leaves a clear waterway.

The hydrant for auxiliary pipe lines, operated by fire-boats, Fig. 3, is a novel type first introduced by this company. These hydrants are fitted with the independent nozzle shut-off, and are generally made for hose of 3½ ins. internal diameter. With these hydrants the powerful streams from fire-boats can be made available in extinguishing fires located some distance from the docks. These and other water-works appliances are manufactured by the Crane Co., of 10 North Jefferson St., Chicago, Ill.

The revenue from the state railways of Prussia not only pays the entire interest on the state debt, but leaves a surplus besides, says the "Volks-wirthschaftliche Wochenschrift." The surplus for 1890-91 was over 103,000,000 marks, or about $25,750,000.

THE DEVELOPMENT OF TECHNICAL SOCIETIES.*

There is a general tendency to the formation of associations and organizations in all branches of labor, trade, industry, commerce, manufacture, science and art. A record giving a list of such associations or the aggregate membership would be startling, and would show how a large percentage of the population of North America is connected with one or more of these. In the foremost class of these are the associations whose primary objects are the investigation and discussion of subjects in which the members are interested, and the publication of the proceedings or transactions for the general advancement of a special trade or profession. The number of associations of this class is greater than is generally believed.

The American Institute of Mining Engineers now includes a membership of nearly 2,400, and prior to its organization in 1887 there was in the United States but one national engineering society and few local organizations, but there are to-day four engineering societies of a national character, with memberships as follows, the scope of membership including many of the prominent engineers of foreign countries:

	Organized.	Present membership.
Am. Soc. Civil Engrs	1865	1,650
Am. Inst. Mining Engrs	1871	2,400
Am. Soc. Mech. Engrs	1880	1,650
Am. Inst. Electrical Engrs	1886	650
Total		6,350

There are also national associations closely allied to engineering, which have obtained prominence and have done much service, including the associations of master mechanics, master car builders, railway superintendents, car wheel makers, boilermakers, founders and others. To the national associations are also to be added a class of local or district engineering societies or clubs, some of which have 500 members. Canada is alive to the necessity of technical societies, having the Canadian Society of Civil Engineers (membership, 700), the General Mining Association of Quebec, Provincial Mining Association of Ontario, the Mining Society of Nova Scotia, the Asebstos Club and others.

It is unnecessary to trace the history of foreign associations of engineers, beginning with the social club

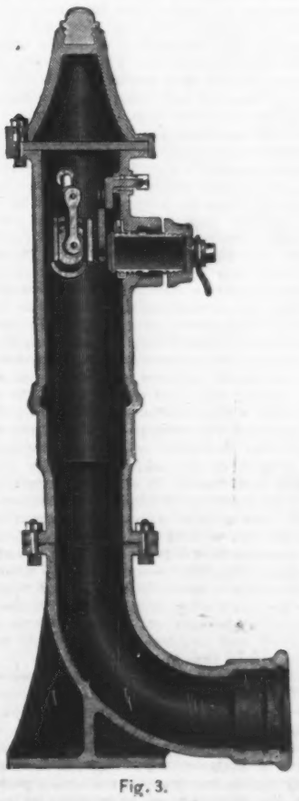


Fig. 3.

claimed to have been organized by Smeaton about 1771, not to mention the number of associations devoted to engineering, or kindred societies, as given in the "Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland." The Institution of Civil

* Abstract of address of Mr. John Birkinbine, retiring President of the American Institute of Mining Engineers, at the annual meeting, at Montreal, February, 1893, as reported in our issue of March 2.

Engineers, of Great Britain, has over 6,000 members; the Society des Ingenieurs Civils, of France, 1,300; the German societies of civil and mechanical engineers, 6,000 each; the Iron and Steel Institute, of Great Britain, 1,500; the Verein Deutscher Eisenhenteulente, 1,000; and there are societies in Russia, Sweden, India, Australia and other parts of the world. The work of these societies is recognized in improved methods and processes, in the growing appreciation of technical education, and in the general advancement of the science. A great part of the progress made, as represented by increased production and decreased cost, is due to the development of the societies, and in many cases men have been better equipped and better able to contend with the problems before them, because of their connection with the technical societies, bringing to them the papers and discussions, and much is undoubtedly due to the closer personal acquaintance and friendship.

During the existence of the American Institute of Mining Engineers, 1871 to 1893, the annual output of iron ore has, in the United States, increased from 3,000,000 to over 16,000,000 gross tons, making this country the largest producer; while for the past decade nearly 1,000,000 tons of foreign ore per year have found a market here. At the time of the organization of the Institute, the Lake Superior iron district produced about 800,000 tons of ore per annum, and had shipped an aggregate of 4,000,000 tons, while it has now reached an annual output of over 9,000,000 tons, and in the 22 years has furnished about 70,000,000 gross tons. Then the pig iron output was obtained from a number of small furnaces, half using anthracite, three-tenths bituminous coal, and one-fifth charcoal. Now a smaller number of furnaces produce a larger product of pig iron—three-quarters being produced with coke, and the balance with anthracite and charcoal. The increase in output of pig iron has been from 1,660,000 to over 9,000,000 gross tons, while the steel output has increased from 70,000 gross tons to 4,000,000 gross tons during the same period of 22 years; and the Bessemer and open-hearth steel outputs have increased from 35,000 tons and 3,000 tons to 4,000,000 and 600,000 tons per annum.

Copper and nickel production, the coal output, the working and treatment of gold and silver, and other matters, have shown similar increase, while the life of the Institute has seen the rise and fall of hydraulic mining for gold gravels, and the innovation of direct matte smelting; and while much has been done in concentration, this field is still very promising for further development. The introduction of power drills, high explosives and electricity for practical uses are also developments of the same period.

In view of the past, and recognizing that but a small proportion of the membership of any technical society can attend its meetings, the line of advance seems to be in maintaining a high standard for the transactions. The discussions which should follow the presentation of most papers make the contributions more valuable, and, as a rule, bring out information which the original does not contain, and tend to modify the statements therein made. Some organizations print the papers in full before the meetings, and read them by abstract only, making the discussion a prominent feature. Others have the papers read in full and followed by oral debate, but the discussions are often less complete than deserved. Analyses, statistics, tables, etc., can be presented by blank proofs, on blackboards, or on lantern slides with convenience; and if members come prepared to respond promptly, to confine their remarks within a limited time, and closely follow the scheme of the papers, a large amount of valuable information can be imparted. The subsequent value of the publication is likewise dependent upon the promptness and care of revision of the subject matter by the individuals who participated. It seems to be better policy to print a small number of papers fully discussed than to merely issue a large amount of material offering controversial data without discussion. Oral discussions offer the advantages of being more attractive and interesting to those attending meetings than the written discussion; the latter is generally more carefully prepared, but there are points often omitted in written discussion which would be brought out under the spur of personal contact, and members are less likely to take part in the written than in oral discussions.

It seems best to advocate initial oral discussion, supplemented by written data. The interest which attaches to the former draws to the meetings members anxious to hear or to participate, and elicits a variety of opinions which would not be obtained under other circumstances. Such interest once exerted, may draw into the discussion persons who were not present, and thus gain the advantage of subsequent written discussions.

The papers presented at the meetings of technical societies, and the discussions on these papers, supply a record of progress such as it would be impracticable to supply from any other source, and place in the libraries of members a fund of knowledge which otherwise could only be secured by liberal personal outlays for expensive books. Without in any way depreciating the value and importance of books on technical subjects, it may be safely asserted that it is impossible for special treatises to be as closely up to the times as the transactions of technical societies. Another important influence exerted by papers and discussions is in the publicity given them by the trade and technical press. It has been claimed that members of the engineering association devote their energies to papers to be read before the technical societies which otherwise would be contributed directly to the technical press, but it is questionable whether in this particular the press at large is not the gainer (although possibly a limited number may lose special contributors), for the incentive to submit papers for the criticisms of fellow members increases the number of available contributors, and educates many to write for publication who would otherwise be silent.

My effort has been to show the remarkable development of technical societies, giving some reason therefor, and the claim has been made (which seems to be within reason) that the broader sentiment which has caused engineers to unite in associations is responsible for a good share of the industrial advance which has been made. The remarks as to the future increase and the most advantageous means of obtaining from these associations the full value which they offer may be open to criticism, but they are presented after a careful review of the work of numerous engineering societies, backed by a personal knowledge of some of the most important results which have followed the presentation and the active discussion of the papers presented.

THE CONSTRUCTION AND MAINTENANCE OF HOWE TRUSS BRIDGES.

In a paper read before the Engineers' Society of Western Pennsylvania, at its meeting on Feb. 21, 1893, Mr. Charles H. Nicols, gives some interesting details of wooden Howe truss bridge construction and maintenance. While the use of wood in railway bridge construction has been generally abandoned in the northern and eastern sections of the country, the cheapness and excellent quality of the timber in the southwest and on the Pacific coast has caused it to be used to a large extent in the place of, or in combination with, iron. When properly designed and constructed, such structures may be advantageously used, even in cases where financial circumstances might justify something better. Moreover, the time when wooden bridges were used almost entirely in railway construction is not far distant, and a great many of these structures are to be found even on our better railways. The repair and maintenance of wooden Howe trusses is therefore a matter of interest to many railway engineers. The following is an abstract of Mr. Nichols' paper:

There are certain requirements which all works should fulfill, whatever be their material or style of construction, and strength and stability are two essential features which every structure should possess at the expense of everything else. It is also necessary that they be maintained, a thing not always easy to accomplish. The best metallic bridges of to-day are merely modifications of the simplest and best designs which have long been known and used, and it is believed that the wooden Howe truss, with a few departures from the usual practice, can be made to fulfill the present heavy requirements. One serious objection to the Howe truss of the past, and one which has contributed largely to its disuse, was its extreme sensitiveness under the action of a modern train load. This was largely a fault of design, the ratio of the depth and span of the truss being generally too small.

At this point the author enters into a lengthy mathematical discussion of the comparative deflection of wood and steel trusses, which we omit. From this he concludes that the deflection of a wooden truss is about twice as great as one of steel, having the same span, load and depth of truss, but that this ratio being dependent upon the moments of inertia and the moduli of elasticity of the materials will vary. This deflection may be lessened by a reduction of the unit strains, or by increasing the depth of truss, or by a combination of the two. In practice it would be best to use both a deeper truss and lower unit strains. The writer then continues as follows:

For a span of 150 ft. the theoretical depth would be about 35 ft., while ordinarily trusses of this length are given a depth of about 20 ft., a difference of 15 ft. From the preceding conclusions the importance of making the depth of wooden trusses somewhat greater than those of steel is very evident. Since it is advisable to have deeper trusses, it naturally follows that there should be fewer panels. It is customary to have the panel length at least half the depth of the truss, hence the panels should be longer. Again, the fewer the panels the more directly the strains are transmitted to the abutments, a point well worth consideration. As the length of panel increases the bending in the loaded chord will likewise increase. To obviate this as far as practicable, the floor beams should be few in number, as deep as the timber will permit, and as close to the panel point as the web members will allow. Unless the panels are exceptionally long from four to six ordinary floor beams per panel will suffice. The wide spacing of stringers is a means of relief to the floor-beams, and may be adopted in the Howe truss with impunity.

In the re-calculation of old Howe truss bridges the rods are almost invariably found to be the weakest members. In many instances the calculated unit strains in the rods have been found to be very near their elastic limit. Occasionally the chords are somewhat weak, but the diagonals are seldom so. The truss-rods from an economical point of view should always have upset screw ends, as a saving of 1,000 lbs. to 9,000 lbs. per span, depending upon the length, is thus made, as stated in the Engineering News, April 26, 1890, by Archibald A. Schenk, Chief Engineer of the Oregon Pacific R. R. For the sake of convenience in adjustment the rods should be provided with turn-buckles, placed at such a height as to be easily operated. All cast or wrought iron and steel in the structure should be thoroughly painted before and after erection, a thing which is almost invariably neglected.

Perhaps one of the most common ways of strengthening a Howe truss bridge is by the introduction of timber arches, which thrust against the masonry. This method of re-inforcement, although considerably better than none at all, is not so efficient as some have supposed it to be. A comparison between the actual strength of these arches and the strength which they are supposed to have is not so favorable as might be desired. If the load was always stationary and uniformly distributed it is beyond question that the arch would be a satisfactory means of support. Ordinarily the curve of the arch does not vary much from that of a parabola; hence, under these conditions the bending strains will be comparatively insignificant. The only strains of any consequence are the shear and direct thrust which are of little account in the arch itself; but the thrust against the masonry is frequently more than it can resist not having been originally constructed for that purpose. The conditions of an arch under the action of a moving load are radically different. Thus, for an arch with a train load upon only one-half the span, the bending moment is several times greater than when fully loaded. Timber arches as usually constructed are poorly adapted to the resistance of the strains which they are called upon to bear. They are built up with a few courses, varying in thickness and insufficiently bolted together, and have frequently been made with only two courses of timber, as in the old Hand St. Bridge, in Pittsburg. Such construction is not commendable on account of the lack of strength at the joints. Another example of faulty design in the arch is leaving an open space between the courses. Arches should be made of several very deep, thin courses thoroughly bolted and keyed together, aside from having solid and reliable skew-backs. To derive the greatest benefit from an arch, its bending strains must be reduced to a minimum. To realize this, in arches which re-inforce a bridge, the ends of the trusses should be tied to the feet of the arches to prevent the unloaded half from lifting the end of the bridge. The trusses having been sufficiently strengthened to prevent this distortion, the result of the above will be more satisfactory than the usual way.

Another method of re-inforcement which is often employed in short spans in the knee brace or strut, one end of which sits in a pocket in the masonry, while the other simply bears against the upper or lower chord of the truss. This contrivance, like the arch, would be of some service if the load was always stationary and uniformly distributed. Since the device is almost invariably eccentrically loaded, however, the benefit which the trusses derive from it is more apparent than real.

The insertion of additional truss rods is another very common and necessary repair, which is scarcely ever neglected. It is usually impracticable to substitute larger rods for those already in use, on account of the holes in the cast angle blocks being too small, hence the necessity of additional rods. It is generally necessary to introduce two new rods at each panel point, except near the center. These rods pass through yokes of timber or metal which bear against the upper and lower sides of the trusses. When timber yokes are used it is necessary to place them a little to one side of the panel point to not interfere with the old rods, for otherwise these would have to be lengthened in order to pass through the yokes. A more satisfactory detail is the iron yoke placed directly at the panel point and made to bear against wrought iron or steel plates of such proportions as to properly distribute the pressure over the chords. These yokes are made of bars set up edgewise, welded and bent into a

rectangular shape, and having a portion of the top cut away to give access to the old nuts.

The chords may be strengthened by the addition of an extra strand on each side, thoroughly bolted and keyed thereto. This is often done in connection with additional rods, and new lateral and sway bracing. Within the limits of a brief observation it has been hard to find an old bridge which has not been subjected to such a treatment. It is an easy matter to increase the sectional area of each individual member of a shallow truss, thereby obtaining the proper amount of strength; but to acquire the desired degree of stiffness is a different matter.

Extra precaution should be taken to protect the timber from the weather, as by so doing the life of the bridge may be greatly prolonged and enough gained to more than meet the expense. The sides should be boarded up and the cracks thoroughly battened. Perhaps the most satisfactory covering for a through bridge is the old-fashioned cedar shingle roof, sheet iron or tin being objectionable on account of the corrosive action of the gases from the locomotives. Considerable difficulty has been experienced in obtaining a watertight covering for deck bridges. Sheet iron or tin fails to give satisfactory results, notably on those roads which transport Chicago beef; since the brine from the refrigerator cars causes rapid corrosion. Gravel decks are not much better, besides being inconvenient in case of repairing the bridge. A good covering, and one which fulfills the requirements as well as any, is one consisting of two thicknesses of pine sheathing laid to break joints, with a coat of paint on top and between. Finally, it may be said that under the proper conditions the Howe truss, when well designed and properly built, is a serviceable structure, easy of maintenance and of moderate first cost, and well suited, even at this time to cheap construction, where timber is plenty.

A VARIABLE-SPEED PULLEY.*

Every constructing engineer and designer knows how often it is desirable to provide a speed-adjustment between parts of a machine performing different functions, or between a prime mover and the devices to which it furnishes power, and how bulky and unsatisfactory are most of the methods by which the result is usually accomplished. The step-pulley is the most simple and generally used. It requires parallelism of shafts, a considerable distance between centers, and a cessation of power during the change from one speed to another. Add to this the necessity for careful design in order to obtain equal belt-tension for all positions; the weight and bulk required for a wide range; and the operative's positive conviction that better results could be obtained at a speed intermediate between those furnished by two successive steps, and we begin to realize the mechanical shortcomings of this old and familiar friend. The hundred and one other devices, patented and otherwise, for accomplishing similar results present other objections of varying importance, which need not be discussed here.

Without pretending to overcome these entirely, and indeed without claiming absolute novelty, a recent invention of Mr. E. F. Gordon, of Dover, N. H., has seemed to the writer to offer such advantages in flexibility and range of application as to merit a more extended study and use than can be given in his own work, to which it is being applied as rapidly as opportunity permits. The device consists of a narrow pulley with a deep V-groove, split by a plane passing through the bottom of the groove, one of the two symmetrical parts so formed being fixed to the shafts, and the second being capable of adjustment so as to bring the faces of the groove nearer or farther apart. By the use of a narrow or round belt, and with faces having the proper angle, the working radius may be varied within wide limits, while a loose sheave may be inserted between the two pieces, thus combining the differential-speed principle with the equivalent of a tight-and-loose pulley.

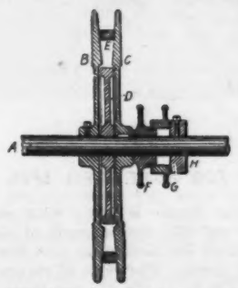


Fig. 1.

In Fig. 1, A is the shaft; B, C, are the two halves of the pulley; D, is the idler; E, the belt; F, G, handwheels; H, a collar, fast on the shaft. By the action of the belt, B and C tend to separate from each other; and since B is fast on the shaft, A C (which is splined on the shaft, and hence must turn with it, although free to move along it) is forced against F. The handwheels, F and G, are free to turn on the shaft, but may be held at rest whenever desired. The hub of one carries a male screw, and that of the other a female, so that by altering the position of one on the other they increase or decrease the distance between the collar, H, and the half of the pulley, C, thereby allowing C to recede to a greater or less distance from B, and determining the position of the belt, E, and its consequent speed relative to that of the shaft, A. It will

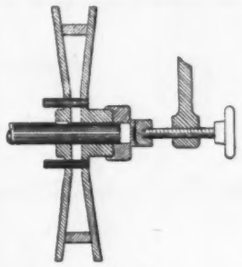


Fig. 2.

be evident that in this construction, when used as a driving shaft, the belt-speed will become less and less as F is screwed into C, until C has so far receded from B as to allow the belt to drop on to the idler, P, when the driven mechanism will come to a standstill, to be gradually started again by the adjustment of F and G.

Fig. 2 shows a still simpler form, applicable when the pulley is located on the end of a shaft. In this case the loose pulley is omitted, it being assumed that only a speed adjustment is necessary, one part of the pulley being fast on the shaft, the other free but loosely pinned to the first so as to rotate with it, and the working radius being determined by the adjustment of a

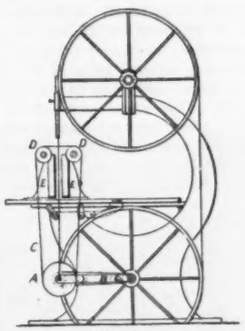


Fig. 3.

hand screw. The belt may be either round or nearly square in section, though, for most of the experiments so far made, a narrow double-ply leather belt has been used, with the edge beveled to correspond with the angle of the pulley's face.

The construction shown in Fig. 2 has recently been applied to the feeding-rolls of a 48-in. band-resawing machine in a way which illustrates its simplicity and adaptation to this class of work. Fig. 3 shows the arrangement of parts, A being the split pulley, its shaft being driven by a link belt from a continuation of the lower band-wheel shaft, and supported by an arm, B, swinging from this as a center. The belt, C, drives the pulleys, D, D, on horizontal shafts worm-geared to the axes of the feed rolls, the swing of the arm, B, compensating for the varying length of the belt, C, owing to changes either in position of the feed rolls, E, with reference to the saw, or in the working radius of A, the latter being determined by the position of a hand screw.

The diameter of the split pulley is 12 ins., the minimum working radius 3 ins., giving a linear speed to the surface of the feed-rolls of from 10 to 30 ft. per minute. A double ply belt, 1 in. wide, is used, and its power is such that if the stock be held firm, the slip occurs between it and the feed rolls (four in number, all geared, 18 ins. long, 3 ins. diameter), and not at the belt, as in the case of the usual style of cone pulley employed in another machine of the same capacity.

It will be seen that, unlike most devices of the kind, this one does not require parallelism of the driving and driven shafts; the distance between the shafts may be varied almost at will; speed may be adjusted to a fraction of revolution within prearranged limits; these limits are wider than could be secured by most other methods at an expenditure of a much greater amount of material and space; and, finally, adjustment of speed may be made while under load.

*Abstract of a paper by H. C. Spaulding, presented at the Montreal meeting of the American Institute of Mining Engineers, February, 1893, as noted in our issue of March 2.

AN INTERESTING EXAMPLE OF FALSE WORK CONSTRUCTION.

By. J .F. Jackson.

The accompanying illustrations show the method of false works construction adopted in erecting a railway bridge under unusually difficult circumstances. As it presents some novel points, and was unusually cheap and efficient, a brief description of the work may be of interest.

The Pacific extension of the Great Northern Ry. follows the right bank of the Pend d'Oreille, or Clark's Fork of the Columbia River, from Sand Point, Idaho, for a distance of 25 miles, to Albeni Falls, near the Washington state line. The river throughout this distance has an average width of nearly 1,000 ft. At Albeni Falls it is divided by a rocky island two or three acres in extent, into two narrow channels of unequal width through the solid rock. The large volume of water which flows through these rifts, or channels, has a fall of 6 or 8 ft. This island was selected as the most favorable point for carrying the railway across the river on the way toward Spokane, and Mr. E. H. Beckler, Chief Engineer, called for bids for two railway spans to be built according to "Cooper's Specifications, Extra Heavy A." One was a 300-ft. span, to cross the first, or large channel, at a point about 170 ft. above the fall, and the other a 180-ft. span, to cross the smaller channel from the island to the left bank, at a point about 150 ft. below the fall in that channel. The contract for both bridges was secured by the Wisconsin Bridge & Iron Co., of Milwaukee, Wis., and the writer was given engineering charge of the erection of the two bridges, which were completed in May, 1892.

While the falsework designed for the 180-ft. span is in many particulars the most interesting, the construction of that under the 300-ft. span was unusually difficult on account of the rapid current and the uneven character of the rock bottom. It will be seen from the map showing the location of

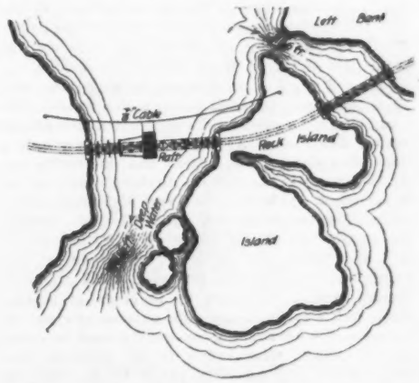


Fig. 1. Map Showing Location of Bridge Over Pend d'Oreille River, Great Northern Ry.

the two spans (Fig. 1) why the current at the 300-ft. span was so strong. The pressure against a board 1 ft. square, held by a spring balance at right angles to the current at the surface of the water, was 40 lbs. As the pressure increased rapidly with the depth below the surface, the average pressure was probably 50 lbs. per square foot. The depth of the water was about 26 ft.

In preparing the plans for the falsework at the 300-ft. span, it was deemed best to erect heavy bents at intervals of 50 ft., and at points directly under the vertical posts of the bridge, and to support the sub-panel beams and traveler trucks between these bents, as shown in Fig. 2. Each bent was subjected to a load of 80 tons, and was constructed of eight round tamarack timbers, 10 ins. to 12 ins. in diameter at the top, and 65 ft. long, braced together, as shown in Fig. 3. All the timber was cut on the banks of the stream some distance above the falls and floated down to the bridge site in rafts. The bracing and deck timbers were hewed on two sides, but all the other timbers were left round.

To erect the bents, a ⅞-in. cable was stretched across the stream, just above the line of the bridge, and to this cable was anchored a heavy cedar raft,

30 ft. × 50 ft. After the soundings were made the two vertical posts and all bracing for a bent were framed and put together on the raft. A crib 38 ft. × 8 ft. × 4 ft., made of round poles, was built on shoes 8 ft. long, which were fastened to the ends of the vertical posts. The end sections a and b of this crib were partly filled with stone, the whole structure tipped up and sunk, and then the center section filled with stone. During the process of tipping the bent up to position, it was held upstream by heavy lines attached to the cable. It should be noted that the middle section of the crib was only partly bottomed so that the friction of the stone on the river bed would prevent sliding. The heavy double batter posts were then erected, one piece at a time, and bolted to the bracing. The bents were then sawed off at the requisite height and capped. By erecting the bents in this manner, it was assured that the legs of each bent rested firmly on the rock bottom, however uneven it might be. This method was used in erecting all piers except those less exposed to the action of the current, where the cribwork was not used.

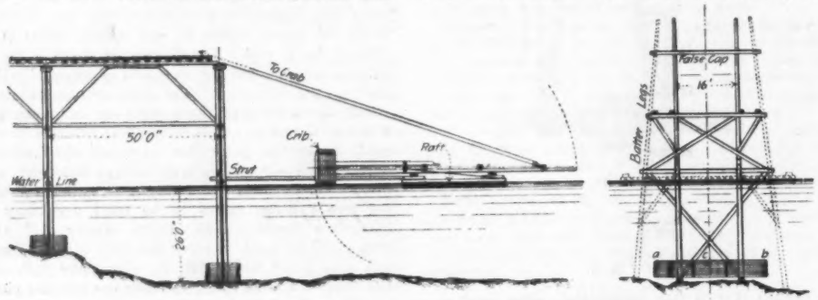


FIG. 2. CONSTRUCTION AND METHOD OF ERECTING FALSEWORK BENTS FOR 300-FT. SPAN.

At the 180-ft. span an entirely different style of falsework was adopted. The situation here at the time the falsework shown in the illustrations had to be put in, was about as follows: The time was the latter part of March. Snow covered the ground to a depth of 3 ft., and the nearest railway point was 35 miles away, by trail through the woods. We could obtain no sawed timber except a few planks floated down over the rapids from a saw mill a few miles above. The island was inaccessible except by row boats, and the timbers could not be delivered at grade at either end of bridge on account of incompleted rock cuts. The line crossed the canyon at a point about 150 ft. below the fall, and where the width of the stream at the water line was 150 ft., the rock walls standing nearly vertical for 50 ft. up to grade of bridge. The water was 40 ft. in depth, as near as could be determined, and running so swiftly that it could not be crossed with safety in an ordinary row boat. There was an eddy about 10 ft. wide on the side next to the island, and another 30 ft. or 40 ft. wide next to the left bank. It was clearly impossible to put in any false work in the water.

Fortunately long straight timber, growing on the bank of the river, a mile above, could be had for the cutting. I therefore designed the "arch" shown in the photographic view and the drawings. (A false work of a very similar design was illustrated in Engineering News, Oct. 13, 1888.—Ed.) The dead and live loads together amounted to 420,000 lbs., all of which was considered as dead load, and disposed as shown on framing plan. The length of span was 156 ft., the depth 30 ft., and width between trusses 26 ft. This width was necessary to accommodate the outside traveler, which had been used for raising the 300-ft. span. Of course the possibility of erecting the arch itself had to be kept foremost in mind, it being necessary to connect the several pieces "in the air." A satisfactory solution of these difficulties having been found, a bill of timber was made out, and men sent into the woods to cut it.

For compression members, spruce and tamarack were selected, and for tension members a very tough fir, not easily split. It will be noticed that the arch contains only two tension members, and that the diagonal bracing was so arranged as to throw as little strain on the tension members as possible, and as much strain as possible on the compression members, with the result also of making it easier to frame the several joints. The deck timbers were so arranged as to bring the loads only at panel points. No strain was allowed to exceed 400 lbs. per sq. in. net section in tension or compression. The timber, after being cut in the woods was hauled to the river, floated down stream over the fall, caught below and hauled to the bank, where it was hewed on two sides and framed ready for erection. It was afterward towed 600 ft. upstream to the bridge site, one or two pices at a time, as needed. Some rock blasting was done in order to prepare the wooden "skewback," after which, with some difficulty, a cedar raft was anchored into position in an eddy on the left side. The leaning bent, B, was raised into position, and so arranged that hoisting could be done by crabs from the tower on the left bank.

One piece of the top chord in each half arch, a tree 70 ft. in length with butt end towards center of arch, was then hoisted into position, then one piece of the bottom chord in each half arch, being a tamarack 85 ft. in length, and having a diameter of 18 ins. at the butt and 10 ins. at the top, was raised to position, the butt resting against a skewback. This was secured by a ⅞-in. cable running up over the tower and back to a secure anchorage on the bank. One piece each of the diagonals, a, b, c, d, e, were then raised and spiked to their connections to top and bottom chord pieces by three or four ½ × ½ × 12-in. boat spikes at each joint. The timbers had all been hewed on two sides to 12 ins. in thickness, and varied with the size of the trees, from 12 to 18 ins. in width, and according to the section required. The joints had been so carefully framed that the shoulders, etc., fitted perfectly in every direction. The bottom chord piece was sprung out so as to be spiked against the side of the top chord at the center of the arch. The two incomplete semi-arches swinging from the big bent were next joined together by systems of top and bottom laterals made of 6-in. to 8-in. round cedar poles. The whole weight now suspended from the leaning bent and cables amounted to about 35,000 lbs.

We then went to island side of stream, and by means of a 40-ft. "house derrick," made of poles and having a 40-ft. boom attachment, raised from the water below the several pieces of top and bottom chords and diagonals, and with top and bottom lateral systems joining the structure at the center to the half already raised. Each member of the arch now consisted of a single piece of timber. No further trouble was experienced. The arch was self-supporting, so that the leaning bent and cables were removed. Two more sets of chord timbers and another set of diagonals were then put in with numerous splices, etc., and spiked with boat spikes, as before. The chord pieces were bolted together, two and two, near the joints; the 3 × 8-in. keys across tension members were carefully fitted; the system of deck timbers to carry ironwork and traveler track put on, and we were ready to commence the erection of iron on the false work, which showed little or no settlement or vibration, and was of sufficient strength to carry a railway train. The structure did not contain more than $10 worth of ironwork, all told. The total cost of the falsework span complete was about $1,400, labor costing $2.66 per day.

When we were through with the erection, which was done in 47 hours, only one hour's work in cutting laterals was necessary to let the arch all go down into the river. No accident of any kind whatever occurred during the progress of the work, and tracklaying on our end of the line was resumed without any delay on account of bridge. It is believed that the plan is a novel one, and considering the length of span, the inaccessibility of the location, and the working material at hand, the most economical that could have been designed for the place and purpose. The steel spans were designed by Mr. John Geist, Chief Engineer, Wisconsin, Bridge & Iron Co., and Mr. A. Preston was foreman of erection.

THE MONTE-GENEROSO RACK RAILWAY.

The rack railway ascending Monte Generoso, in Switzerland, was opened in June, 1890, and carries tourists to the summit of a mountain lying between Lakes Lugano and Como, entirely in Swiss territory. The line leaves the steamboat landing at Capolago, at the south end of Lake Lugano, at an elevation of 907 ft. above the sea, and rises to an elevation of 5,203 ft. in a length of 5.6 miles.

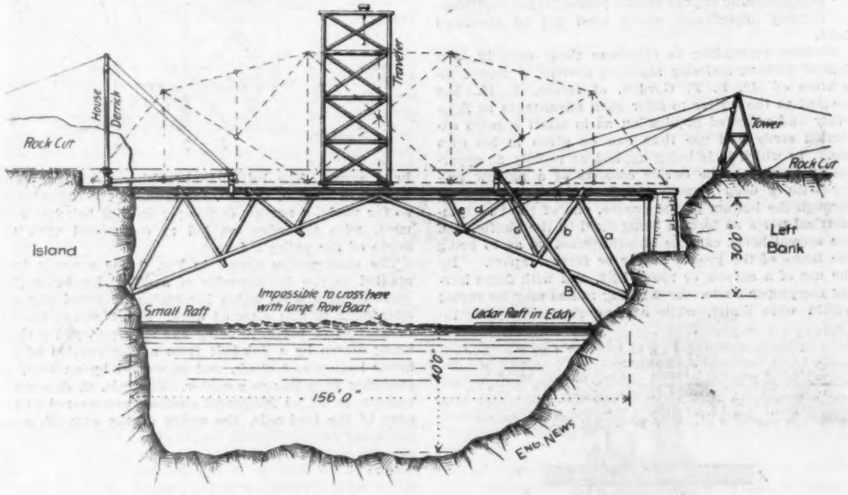


FIG. 3. GENERAL ELEVATION OF FALSEWORK ARCH FOR 180-FT. STEEL SPAN.

The average grade is 15%, with exceptional grades of 20 and 22% over a length of about 1,700 ft. The stations are located on stretches of track having a 5% grade. The radii of curves are generally from 326 ft. to 978 ft.; but there are some curves of about 260 ft. At the stations the switch-curves are laid out to the latter radius. One bridge and five tunnels are upon this line, the longest tunnel being 537 ft. in length.

The gage of the track is 2.6 ft. The roadbed is 13.7 ft. wide, and is made up of 15 ins. of stone ballast, laid between two rough dry stone walls. Below the ballast is a layer of larger stone for

drainage purposes. The rails are of T-section, weighing 40.5 lbs. per yd., and are bolted to steel trough cross-ties weighing about 55 lbs. each. The joints are spliced by four-bolt angle bars. The line is on the Abt rack system, and is laid with two rack bars. This system has been described in our columns. There are six tank engines, built at Winterthur, with four driving wheels, and a pony trailing truck. The cylinders are 12×22 ins., above the frame at the middle of the boiler, with the cross-heads in front, and drive the wheels by means of a rocking shaft and return connecting rod. A 23-in. driving pinion is attached to each driving axle, with a friction brake drum on each side of the pinion. Pinions and brake drums are also fitted to the four-wheel trucks of the cars, being placed between the axles of the carrying wheels. The open cars carry 56 passengers each and are mounted on trucks. They weigh empty 10,560 lbs. The closed cars carry 48 passengers and weigh empty 11,440 lbs. The engines weigh 25,500 lbs.

The total cost of the line to Dec. 1, 1890, was $363,660, including rolling stock, stations, etc.; about $67,343 per mile. The total cost was divided as follows:

Preliminary examination, concession, etc.	$5,272
Interest during construction	10,645
Land	29,765
Plans, surveys and superintendence during work	130,343
Track, etc.	97,025
Buildings	29,719
Telegraph and signals	748
Rolling stock	55,750
Furniture and tools	4,394
Total	$363,660

The concession permits the following charges to be made: Passengers; ascent, $1.50; descent, $1; intermediate rates in proportion; baggage, 5 to 22 lbs., 10 cts.; over 22 lbs., ½ ct. per pound; freight, 12 cts. for 44 lbs. and under, and 6 cts. for every 22 lbs. over 44 lbs.

The total ascent is made in 1 h. 15 m., and the total descent in 1 h. 25 m., the normal speed being 3.72 miles per hour upon the steep grades, and varying at other points from 5 to 6 miles per hour. In 149 days of service the trains carried 19,304 passengers and 1,030 tons of freight. The total of receipts was $18,620 for this period, and the total expenditures were $10,116, leaving a net profit of $8,503.

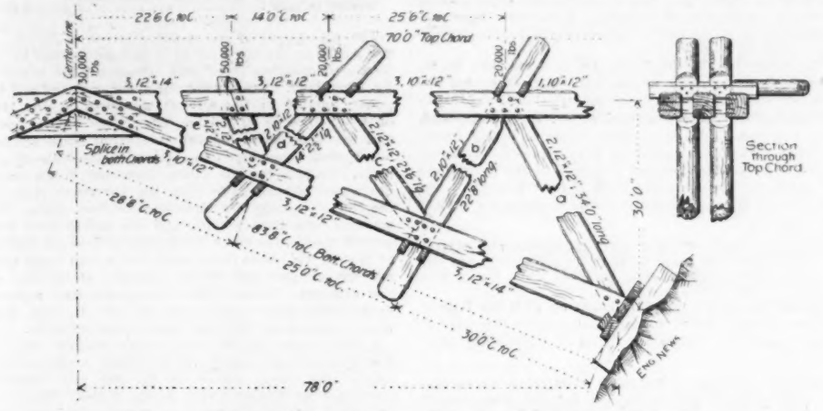


FIG. 4, ELEVATION OF HALF ARCH SHOWING DETAILS OF FRAMING.

FALSEWORK ARCH FOR 180 FT. STEEL SPAN; J. F. Jackson, Chief Engineer.

PERSONALS.

Mr. Alexander Potter has opened an office as engineer at 137 Broadway, New York, N. Y.

Mr. Allen Hagen has been appointed chemist to the Water Department of the World's Columbian Exposition.

Mr. Paul G. Remington, President of the Northwestern Asphalt Co., of Chicago, Ill., died Feb. 24, at the age of 41.

Mr. E. Holbrook has resigned his position as Superintendent of the Pittsburg Division of the Baltimore & Ohio R. R.

Messrs. Hardaway & Reid have opened an office as consulting engineers, in the Stevens Building, San Antonio, Tex.

Mr. John F. Stevens has been appointed Assistant Chief Engineer of the Great Northern Ry., with headquarters at Spokane, Wash.

Mr. John C. Jacobs, who was Superintendent of the Amboy Division of the Illinois Central R. R. for 40 years, died at his home in Amboy, Feb. 27.

Mr. G. B. Bassett, engineer and contractor, 353 Washington St., Buffalo, N. Y., will carry on the business of the firm of Bassett Bros., which has been dissolved. Mr. E. M. Bassett has opened a law office at 40 Wall St., New York, and will make a specialty of corporation law business.

Mr. Randell Hunt, M. Am. Soc. C. E., is delivering a course of six lectures on the "Foundations of Structures" to the students of engineering in the University of California.

Mr. Campbell G. Ellwood, formerly Superintendent of the Philadelphia Gas Co., has been appointed Assistant Superintendent of the Department of Public Works, Pittsburg, Pa.

Mr. Loring H. Goddard has resigned the position of Masonry Inspector on the Ohio Southern R. R., to accept that of Supervising Architect with Mr. Wilbur T. Mills, of Columbus, O.

Mr. John Herron, Engineer of Maintenance of Way of the Great Northern Ry., has resigned to accept a position with the Drum Lummon Co., at Marysville, Mont. His successor is Mr. Patterson, recently with the Northern Pacific R. R.

Mr. C. A. Shackford has been appointed Engineer of Maintenance of Way of the Wheeling & Lake Erie Ry. and Toledo Belt Ry. He will have charge of the water supply, maintenance of way and structures, reporting to the General Superintendent, and will have his office at Toledo, O.

Mr. Thomas Henry Bates, Secretary to the Railroad Commissioner of Colorado, died at Denver, Colo., Feb. 21. He was born in Booneville, N. Y., in 1826. He was resident engineer of the Erie Canal at Utica, N. Y., was a division engineer during the construction of the Union Pacific Ry., and was Chief Assistant Engineer under Trenor W. Park in building the Panama R. R.

Mr. James T. Taylor, for the past two years Engineer in Charge of the Bear Valley Irrigation Co.'s work, now Chief Engineer of the Riverside Construction Co., and Mr. Ernest J. S. Pursslow, formerly Locating Engineer to the Arrowhead Reservoir Co., have entered into partnership, with head offices at Riverside, Cal., and are now engaged upon some extensive irrigation work.

Mr. John F. Curtis, who died recently at Seattle, Wash., was for many years Master Mechanic of the Oregon Ry. & Navigation Co. at The Dalles, and afterward held the same position with the Northern Pacific R. R. at Sprague, Wash. He was engaged by the Baldwin Locomotive Works to go to Chile and superintend the setting up some engines, and remained there three years.

Mr. E. T. Brooks, Engineer of Maintenance of Way on the New Jersey Division of the Pennsylvania R. R., has accepted the position of Superintendent of the Philadelphia, Wilmington & Baltimore R. R., Maryland Division, and will reside in Wilmington, Del. Mr. L. H. Barker, of Williamsport, Pa., Engineer of Maintenance of Way on the Philadelphia & Erie, will succeed him.

Capt. George McC. Derby, Engineer Corps, U. S. A., is relieved from duty at the West Point Military Academy and is made assistant to the Engineer Commissioner of Washington, D. C., relieving Capt. James L. Lusk, Engineer Corps, U. S. A., who takes Captain Derby's place at West Point. Captain Derby graduated at the head of the class of 1878, and his name is well known to residents of New York as the engineer, under General Newton, in charge of the tunneling and blowing-up of Flood Rock, near Hell Gate. He remained on duty in New York Harbor until 1880, since which time he has been at West Point.

Mr. F. D. Casanave, for several years Superintendent of Motive Power of the Pennsylvania Co.'s lines west of Pittsburg, is reported to have been made General Superintendent of Motive Power of the same lines east and west of Pittsburg, to succeed Mr. Theodore N. Ely, who has been appointed Director of Motive Power of the Pennsylvania R. R. lines, with headquarters at Philadelphia. Mr. Casanave's headquarters will be at Altoona. Mr. George L. Potter, Master Mechanic of the Pittsburg, Fort Wayne & Chicago shops of the Pennsylvania Co., has been appointed Superintendent of Motive Power of the northwest system of the Pennsylvania lines west of Pittsburg, and is succeeded by Mr. W. Atterbury, who has been Assistant Superintendent of Motive Power under Mr. Casanave. The headquarters of Mr. Potter and Mr. Atterbury will be in Fort Wayne.

NEW PUBLICATIONS.

MARCH MAGAZINES.—"Artesian Wells in the Arid Region" is the title of a paper in the "Popular Science Monthly" that deserves careful study by every engineer interested in the development of underground water supplies for irrigation or other purposes. The main point made by the author is stated in the following quotation:

Mountain rocks are not the source of great artesian wells; neither do they usually occur in synclinal valleys, but the most favorable conditions are gently sloping monoclinal plains in which the receiving areas, instead of being the ruptured mountain rocks, are, in fact, the escarpment valleys of the plains.

In the same magazine the paper on the development of the glass industry in America is concluded. The

history of the plate glass industry is especially interesting. The annual output of American polished plate is now nearly one-third of a square mile. The product is now "quite equal in quality to the imported, and promises soon or later to so discourage importation as to be itself exported." This branch of glassmaking is now the most flourishing of all departments of the industry, the reason being that machine work is utilized in nearly every stage, and competition with the cheap hand labor of Europe is easier. There are now eight plate glass works in operation, and four more are under construction. The influence of natural gas in building up the glass industry may be understood when it is stated that a factory whose weekly expense account when using coal in 1883 was $175.17, was operated by natural gas in 1885 for $94.96 per week, a saving of 46%. In addition to this the repairs were less costly, and the product was of better quality and more salable. The New Jersey works have met the natural gas competition by substituting the "tank furnace" for the old-fashioned "pot" furnace, and are now substituting crude petroleum for coal as fuel. A bottle blowing machine is the latest invention, which promises to revolutionize the bottle making industry. Two other papers in this number which deserve mention discuss, respectively, the world-wide movement of population from the country to the city, and the revolution wrought in agriculture by the use of insecticides and germicides.

"Harper's" has a paper by Henry M. Stanley, on the slave trade in Africa, which enables one to gain some idea of the plans and purposes which European statesmen had in view when the partition of the Dark Continent was effected (see map in Eng. News, Nov. 21, 1891).

In "Scribner's" the Jaffa & Jerusalem Ry., completed last August, is described and illustrated. The author states that the first train ran into the Jerusalem station on Saturday, Aug. 27, and not on Aug. 21, as has been generally stated. It appears that the most difficult part of the whole enterprise was the transfer of the imported materials and rolling stock from the steamer to the shore; a special pier had to be built reaching out into deep water, but the difficulties of unloading were so great that some bulky, but floatable things, among them the locomotive boilers, were thrown overboard and towed ashore. As a contrast to this bit of Western civilization in Asia Minor, we have a description of a caravan journey from Tripoli across the Sahara and Soudan to Lake Tchad.

A paper of exceeding interest in "The Century" is on Napoleon's deportation to the island of Elba, written by the commander of the vessel which carried him there, Admiral Thos. Ussher, R. N.

In the "Californian Illustrated Magazine" is a paper on the state of Washington, by Hon. F. I. Vassault. Judging from his account of the state the booming of cities has been as much overdone there as in the other states which during the past ten years have been the scenes of forced development. In a total population of 122,000 in the part of the state lying between Puget Sound and the Cascade Mountains, 92,000 are residents in cities. Fortunately, there are natural resources sufficient to warrant a large industrial development, for these cities could not possibly be sustained merely by the commerce of the surrounding country. Another article in this issue discusses the annexation of Hawaii. It is generally supposed in the East that the Pacific Coast is a unit in favor of annexation; so it is surprising to find this writer strongly opposing it. The concluding article describes the glaciers of the Sierra Nevada.

In the "North American Review" Prof. N. S. Shaler has a very interesting paper on "High Buildings and Earthquakes." It will not reassure dwellers in ten-story apartment houses or occupants of great office buildings in the Atlantic Coast cities to hear Professor Shaler say that should the Boston of to-day be shaken as severely as the city which stood on its site in 1775, "a vast loss of life and property would inevitably result." That he is correct, however, may be judged from his statement that in that earthquake bricks thrown from the top of a chimney 32 ft. high struck the ground 30 ft. from its base. Professor Shaler holds that the architect of a building intended to endure for centuries should recognize the probability that earthquake shocks may at some time strain the structure. The increasing use of steel skeleton structures is alluded to as a measure likely to result in much greater safety; but the general reader is likely to obtain a mistaken impression from Professor Shaler's reference to structural metal as "iron, or rather low grade steel." Of course engineers know that structural steel, or, at least the quality which their specifications call for, is very far from being "low grade." We must also take issue with Professor Shaler on his statement that "any very general use of steel in great buildings is apt to come about slowly." On the contrary, with the rapidly decreasing price of steel and constant improvement in its quality, it is fast becoming not only the best, but the cheapest building material, all things considered. It may comfort our Chicago readers to know that Professor Shaler considers the Great Lake region pretty secure from any seismic disturbances.

"The Independent" for March 2 has an interesting symposium on electrical subjects, the contributors including among others Messrs. Park Benjamin, Wm. L. Saunders, Moses G. Farmer, Nelson W. Perry, F. B. Crocker and Geo. F. Barker. The most important applications of electricity are discussed by the writers in a popular manner.

In "Harper's Weekly" for March 4 we find an attempt to make clear to the non-technical reader the complexities of the electro-pneumatic block and interlocking system; also a portrait of Mr. E. C. Shankland, M. Am. Soc. C. E., with some words of hearty praise for his work in designing the great roofs of Machinery Hall and the Manufactures Building, at the Columbian Exposition. The dynamite guns of the "Vesuvius" and the new battleship "Indiana," also come in for a brief description.

BIENNIAL REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF OREGON, for the two years ending Jan. 1, 1893. Pub. Doc.; 8vo, paper; pp. 583.

Nearly all of the report is taken up with the reports of the separate railway companies and the decisions of the commission. There is nothing of engineering interest.

REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF KANSAS, for the year ending Dec. 1, 1892. Pub. Doc.; 8vo, cloth; pp. xvi. + 294; map.

All but the first 16 pages of this report is taken up with the separate reports of the various companies and the commission's decision. There is little of technical interest.

REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF VERMONT, for the two years ending June 30, 1892. Pub. Doc., 8vo., cloth; pp. 881 + xcviii.

The report shows a fair general improvement in the roadbed and structures of the various companies, and very satisfactory progress in the introduction of steam heating. There is little else of especial interest.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting held March 1, Mr. Charles Brush, Vice-President, in the chair, a paper by Mr. G. Bouscaren, on "The Restoration of the Cable Ends of the Covington & Cincinnati Suspension Bridge," was read. This bridge was completed in 1867. It has a center span of 1,057 ft. and side spans of 281 ft. each. The cable system is composed of two main cables 12½ ins. diameter, re-enforced by 76 inclined stays 2½ ins. diameter. The anchor chains and cable ends are imbedded in masonry laid in cement. The masonry of the anchor walls was ashlar faced, with rubble filling laid in Louisville cement mixed with lime, and the whole capped with large stones jointed with pitch.

Each main cable consists of seven strands, each containing 740 iron wires of 1-60 sq. in. sectional area. The ultimate strength of one cable was estimated at 4,196 net tons. Each cable is wrapped continuously with No. 10 wire, the wrapping extending 1 ft. into the masonry. From this point the strands diverge and connect to the anchor chains at 15 ft. back, by 4½-in. pins. Each of the strands divides into four parts, each part being looped around a cast shoe, through which the pin passes. In 1891 it was decided to have the work examined. The masonry was found to be irregular in quality and poorly laid. The mortar in immediate contact with the wires was impregnated with iron rust, which formed a crust around the wires which was removed with difficulty. After removal of the rust, the section of the outside wires was found to be considerably reduced, causing an estimated loss of one-eighth of the strength of the cable. Tests of twelve pieces of wire where they were in the best condition showed 2% average loss of strength.

To restore the strength of the cables there were attached to each one four auxiliary iron bars, 1 × 3 ins. These were looped over the ends of the pins at the upper ends of the anchor chains, thus giving 24 sq. ins. of section, and attached to the cables outside the walls. The outer ends of the bars were threaded, and the bars made taut by screwing up the nuts upon them. Then 30 collars, 4 × ¾ ins., were clamped on each cable with two bolts. Each collar was dressed true on the edges, and fitted closely to those adjacent, so as to form a continuous sleeve 10 ft. long over the cable. Four 5 × 5 in.-angle irons, 5 ft. long, with bars 1½ × 5 ins. between, were riveted to the ten collars furthest from the anchor bars, to form a bearing for the head block against which the nuts upon the auxiliary bars pressed. The head block was made of six steel plates 2 × 13 × 26 ins., dressed on all faces and assembled together, breaking joints, and joined by 20 turned bolts 1¼ ins. diameter, with countersunk heads.

Estimated tensile stress in a clamp bolt	18,000 lbs.
Aggregate pressure on the diameter of the cable from 60 bolts = 60 × 18,000	540 tons.
Frictional resistance from the same on ⅓ of the circumference of the cable, supposing a uniform rate of pressure normal to circumference ⅓ × 0.25 × 504 × π	401.4 "
Estimated loss of strength of cable	525 "
Safe working stress of the auxiliary bars being ¼ breaking strength of all	120 "
Marginal safety of frictional resistance over tension in bars	3.34 "

The adjustment of the working stress of 10,000 lbs. per sq. in. in the auxiliary bars was determined by the measured compression of lead cylinders 2 ins. diameter by 3 ins. long. These were put under each nut and the power applied to the wrench measured at the time of a compression of 0.6 in. They were then removed and the same power applied to the nut when screwed home, care being taken to thoroughly lubricate all the parts. To preserve the cables from rust in the future the whole of each cable from the lowermost clamp to the end is inclosed in a tight wrought-iron casing. The masonry was then rebuilt, and the casing filled with parraffine oil. The oil used is known as Zone oil, flashing at 350° F. This is so penetrating that it was found to be steadily escaping and finally appeared at the face of the masonry. It was then withdrawn and replaced by paraffine wax which melts at 116° F. The work was completed in 1892, and has proved effective.

A short paper on "Street Railway Motors," by Mr. Geo. Downe, was read by the secretary, giving particulars of the steam motors on the city and suburban tramways at Sydney, New South Wales. There are five main lines, converging to one terminal line and station, and eight branch lines. There are 106 motors, all four-wheel engines, and hauling one to four cars; 93 engines were built by the Baldwin Locomotive Works, Philadelphia, Pa., 10 by the company, and 3 by English builders. Some particulars of these lines were given in our issue of Oct. 10, 1891.

At the meeting on March 15 a paper by Capt. W. F. Symonds will be read on "Jetty Harbors on the Pacific Coast." The following candidates were declared elected. Members: George B. Bassett, Buffalo, N. Y.; Geo. W. Bramwell, New York, N. Y.; John C. Chase, Wilmington, N. C.; Ernest V. Clemens, New York; N. Y.; W. B. W. Howe, Knoxville, Tenn.; F. B. Locke, Boston, Mass.; Samuel L. Minot, Boston, Mass.; W. A. Post, Newport News, Va.; Gustave A. Roullier, Flushing, N. Y.; Nelson O. Whitney, Madison, Wis. Associate Members: Herbert C. Alden, Yonkers, N. Y.; William Gray, Carmel, N. Y.; Henry D. Wood, Newton, Mass.

The following circular has been issued in regard to the arrangements for the department of Civil Engineering at the International Engineering Congress to be held at the World's Columbian Exposition:

A circular note was issued in 1891 to every member of the Society, asking for subscriptions to the sum of $3,000 toward defraying the expense of maintaining suitable headquarters for the accommodation of engineers during the Columbian International Exposition of the present year. This sum has been fully subscribed, and the Board of Direction of the Society now finds it necessary to call for a much larger subscription to enable it to perform the duty, which it has assumed, of the direction and management of the department of the Engineering Congress devoted to civil engineering.

Ninety-eight papers have thus far been promised, and others may yet come. These are distributed as follows: From the United States, 36; Germany and Austria, 26; England, Scotland and Ireland, 10; Portugal, 6; Italy, 4; Holland, 4; France, 2; United States of Colombia, 2; Mexico, 1; Argentine Republic, 1; Russia, 1; Australia, 5. They cover a large portion of the subjects on which papers were invited, and most of them from the foremost engineers of the countries named.

The preparation of plates, translation, printing, proof-reading, postage, etc., involve a large expense, and, if done well, must begin immediately. If but three-fourths of the number shall be received, and they average but twenty printed pages each, it will make two volumes somewhat larger than those of last year's "Transactions." In addition to this will be the discussions, which may be had at Chicago. Limiting the estimate to the papers only, and allowing for an edition of 1,000 more than the usual number, the cost will be about $14,000. If those volumes take the place of the "Transactions" for the last half of the year, the extra cost to the Society will be about $9,000, or if we allow the very moderate sum of $3,500 for printing the discussions, this would be $12,500.

The Board has appointed a committee to report upon the establishment of a Bureau of Information and Courtesy at the Society's house in New York city, where visiting engineers on arriving may obtain information regarding points of interest in this country, and directions for reaching them. It is believed that such a bureau will prove an important factor in increasing the prominence and usefulness of our Society. The committee estimates the expense of establishing and maintaining such a bureau during the Exhibition at $2,500.

The Board of Direction, in view of these facts, deems it its duty to ask the members to contribute the sum of $15,000 to meet the expenses mentioned. If every member contributes his proper quota, he will make sure of the reception of two valuable volumes from the Congress, the sum will be easily raised, and we shall have the satisfaction of thoroughly upholding the reputation of the Society, and doing well the work we have undertaken.

Prompt replies are necessary, as the work is already upon us, and there is no time to be lost; but the Board cannot incur the expense unless it finds itself upheld by the membership. It should be remembered that this meeting takes the place of the annual convention, and lasts from July 31 to Aug. 5, inclusive.

A short paper on "Street Railway Motors," by Mr. Geo. Downe, was read by the Secretary, giving particulars of the steam motors on the city and suburban tramways at Syndey, New South Wales. There are five main lines, converging to one terminal line and station, and eight branch lines. There are 106 motors, all four-wheel engines, and hauling one to four cars; 93 engines were built by the Baldwin Locomotive Works, Philadelphia, Pa., 10 by the company and 3 by English builders. Some particulars of these lines were given in our issue of Oct. 10, 1891.

At the meeting on March 15 a paper by Capt. W. F. Symonds will be read on "Jetty Harbors on the Pacific Coast." The following candidates were declared elected: Members—George B. Bassett, Buffalo, N. Y.; Geo. W. Bramwell, New York, N. Y.; John C. Chase, Wilmington, N. C.; Ernest V. Clemens, New York, N. Y.; W. B. W. Howe, Knoxville, Tenn.; F. B. Locke, Boston, Mass.; Samuel L. Minot, Boston, Mass.; W. A. Post, Newport News, Va.; Gustave A. Roullier, Flushing, N. Y.; Nelson O. Whitney, Madison, Wis. Associate Members—Herbert C. Alden, Yonkers, N. Y.; William Gray, Carmel, N. Y.; Henry D. Wood, Newton, Mass.

The following circular has been issued in regard to the arrangements for the Department of Civil Engineering at the International Engineering Congress, to be held at the World's Columbian Exposition:

A circular note was issued in 1891 to every member of the Society, asking for subscriptions to the sum of $3,000 toward defraying the expense of maintaining suitable headquarters for the accomodation of engineers during the Columbian International Exposition of the present year. This sum has been fully subscribed, and the Board of Direction of the Society now finds it necessary to call for a much larger subscription to enable it to perform the duty, which it has assumed, of the direction and management of the department of the Engineering Congress devoted to civil engineering.

Ninety-eight papers have thus far been promised, and others may yet come. These are distributed as follows: From the United States, 36; Germany and Austria, 26; England, Scotland and Ireland, 10; Portugal, 6; Italy, 4; Holland, 4; France, 2; United States of Colombia, 2; Mexico, 1; Argentine Republic, 1; Russia, 1; Australia, 5. They cover a large portion of the subjects on which papers were invited, and most of them from the foremost engineers of the countries named.

The preparation of plates, translation, printing, proof reading, postage, etc., involve a large expense, and if done well must begin immediately. If but three-fourths of the number shall be received, and they average but twenty printed pages each, it will make two volumes somewhat larger than those of last year's "Transactions." In addition to this will be the discussions, which may be had at Chicago. Limiting the estimate to the papers only, and allowing for an edition of 1,000 more than the usual number, the cost will be about $14,000. If those volumes take the place of the "Transactions" for the last half of the year, the extra cost to the Society will be about $9,000, or if we allow the very moderate sum of $3,500 for printing the discussions, this would be $12,500.

The Board has appointed a committee to report upon the establishment of a bureau of information and courtesy at the Society's house, in New York city, where visiting engineers on arriving may obtain information regarding points of interest in this country, and directions for reaching them. It is believed that such a bureau will prove an important factor in increasing the prominence and usefulness of our Society. The Committee estimates the expense of establishing and maintaining such a bureau during the Exhibition at $2,500.

The Board of Direction, in view of these facts, deems it its duty to ask the members to contribute the sum of $15,000 to meet the expenses mentioned. If every member contributes his proper quota, he will make sure of the reception of two valuable volumes from the Congress, the sum will be easily raised, and we shall have the satisfaction of thoroughly upholding the reputation of the Society, and doing well the work we have undertaken.

Prompt replies are necessary, as the work is already upon us, and there is no time to be lost; but the Board cannot incur the expenses unless it finds itself upheld by the membership. It should be remembered that this meeting takes the place of the annual convention and lasts from July 31 to Aug. 5, inclusive.

A later circular relating to the annual convention at Chicago, states that it is impossible now to predict whether there will, or will not, be any difficulty in obtaining good accommodations, at moderate prices, if each individual waits until about the time of the convention and looks out for himself.

The general opinion in Chicago seems to be that there will be no great difficulty, and that the supply of rooms will more than equal the demand.

There will be great advantage, however, in having the Society located in a body at one large hotel, convenient to the Art Building, where the sessions of the World's Congresses will be held, and at the same time within easy access of the Exposition Grounds. The Society is prepared to make contracts now, either on the European or the American plan.

The minimum rates at which first-class accommodations can now be secured are: For room only, $3 for each person per day; and for room with board, $5 for each person per day. This figure is based on prices at well-constructed hotels within 10 minutes' walk of the Exposition Grounds, and 25 minutes' by rail of the Art Building; at least two persons to be in an ordinary hotel room, separate beds being provided. It is possible that cheaper accommodations than this may be secured, but at present it is not thought wise for the Society to undertake to provide them. More expensive rooms can now be secured by individual application to the hotels.

Answers to this circular should be sent immediately and must be received by March 20, and each member must agree to pay for the rooms engaged for him whether occupied or not. As the convention is to begin on Monday, many members will probably wish to arrive on Saturday, July 29, and possibly to leave either before or after Saturday, Aug. 5.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—At the annual meeting held at Roanoke, Feb. 22, the following officers for the ensuing year were declared elected: President, Chas. S. Churchill; First Vice-President, J. C. Rawn; Second Vice-President, Prof. J. H. Fitts; Secretary, L. J. Carmalt; Treasurer, J. R. Shick; Directors, Geo. R. Henderson, Geo. P. Wood, R. H. Soule, Clarence Coleman, S. G. Gaillard, M. E. Yeatman; Directors holding over, Prof. D. C. Humphreys, Prof. W. E. Anderson, C. G. Cushman.

Mr. Rene de Saussure read a paper on "The Construction of Theaters from an Optical Point of View," treating the subject geometrically, and determining which is the most rational shape to give to the different floors of an opera house or any assembly hall, circus, amphitheatre, etc., in order to give every one the best possible view of the stage. Some new ideas were suggested and may be of interest to architects in charge of the construction of a theater, by showing how to proceed to establish, first, the vertical section of the auditorium, then the plans of the different galleries.

At the evening session, Mr. R. P. C. Sanderson read a paper on "Heating and Ventilation." He recommended a constant supply of fresh, warm air at 72° F. or thereabouts, the quantity proportionate to the number of persons and gas jets in the room, and the pressure greater inside the building than out. This is most nearly fulfilled, for dwellings of any reasonable size, by the hot air furnace; but for larger buildings, steam or hot water systems must be used, supplemented with a fan to produce the necessary circulation of fresh air.

For the informal meeting of March 15, it was announced that the subject would be, "Recent Progress in the Substitution of Steel for Other Materials in Construction." L. J. Carmalt, Secy.

ASSOCIATION OF CIVIL ENGINEERS OF CORNELL UNIVERSITY.—At the meeting on March 3 Mr. Emile Kuichling, of Rochester, lectured on "Storm Water in Sewers." Both the practical and theoretical treatment of the question were given and many valuable points brought out. This association, which has its headquarters at Cornell University, Ithaca, N. Y., has on its membership roll the graduate and undergraduate civil engineers of the institution, numbering nearly 400 in all. The first volume of the "Transactions," which will shortly be issued, will contain the above lecture, papers by H. G. Prout, on "Railway Accidents," and Desmond Fitzgerald on "Boston Water Works," and three lectures yet to be given.

ASSOCIATION OF ONTARIO LAND SURVEYORS.—The first annual meeting (eighth annual meeting of the Association of Provincial Land Surveyors of Ontario) was held at Toronto, Ont., Feb. 28, March 1 and 2. Reports of officers and committees were read and the following papers were presented: "Geographical Surveying," L. B. Stewart; "History of Tache Gold Field," H. DeQ. Sewell; "Timber Surveys," J. F. Whitson: "The Duties of a Surveyor on the Maintenance of Way Staff of a Railway," W. L. Innes; "Local Improvements," P. S. Gibson; "Summer Resorts," Willis Chipman; "Shall It Be a Tile Drain," H. J. Bowman; "The Mexican Amalgamation Process," Samuel Bray; "Permanent Street Pavements," J. W. Tyrrell; "Drafting," F. L. Foster; "The Transit and How to Use It," Cyrus Carroll; "Drainage Difficulties in the Southwestern Municipalities of Ontario," Henry Winter. The following officers were re-elected: President, Elihu Stewart; Vice-President, M. J. Butler; Secretary and Treasurer, A. J. Van Nostrand.

ENGINEERS' CLUB OF CINCINNATI.—At the January meeting Mr. M. D. Burke read a paper on "Country Roads; The Position which Their Improvement Should Occupy in the International Development of the United States." After briefly referring to the growing interest being taken in the subject of the improvement of the roads of the country within the past few years, and the benefits to be derived therefrom, he outlined a plan of organization and the ways and means for carrying it out, for a department of public works, which should have charge of certain of the works now carried on by the government through its various departments, and that one of the divisions would be that of public roads. It would also have direction of the improvement of inland waterways and drainage, and irrigation streams. He would incorporate the Coast and Geodetic Survey in this department of public works, and have a system of triangulation extended over the entire United States. The scheme to embrace the planning and executing of all public works in the land, the organization of a corps of United States engineers, which should establish lines for the basis of all official surveys and maps and design, and direct the execution of all works properly belonging to the general government, with the exception of those of a military nature or for coast and harbor defense and fortification.

LIVERPOOL ENGINEERING SOCIETY.—At the meeting on Feb. 8 a paper on, "Automatic Sprinklers," was read by Mr. James H. Lynde. After describing the general arrangement of sprinkler installations, and the construction of the "Grinnell," "Witter" and "Titan" sprinklers, he proceeded to demonstrate the properties of sensitive solder. The various parts of the three sprinklers were then put together before the members with the same solder, and their various degrees of sensitiveness were tested by experiments. The result showed that in a uniform temperature the "Titan" sprinkler operates in less than half the time occupied by the "Grinnell" or the "Witter," which is a great advantage in practice, and has the effect of reducing the damage both by fire and water. The principle upon which this high degree of sensitiveness depends was shown to be owing to the insulation of the sensitive joint from metallic contact with the body of the apparatus. The fluctuation of the water pressure was then treated of, and shown to have no effect upon the strains on the joints of sprinklers with fixed valve seats. In the case of flexible valve seats or diaphragms, it was shown that every variation of the water pressure was communicated to the sensitive joint. In America, this fluctuation is called the "water hammer," and is, in the opinion of experts there, very detrimental to the durability of sprinklers. The experiments showed that nothing was to be feared from it in the case of sprinklers with fixed valve seats. The pneumatic arrangement for cold climates was then described, together with a combined differential check valve and alarm, consisting of three valves mounted on one stem, each valve seating itself independently of the others. The paper ended with a short review of the results that have been attained by the adoption of automatic sprinklers.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Feb. 15 a paper was read by Mr. O. W. Ferguson on "Methods and Results in Precise Leveling." He described the instrument used, the methods employed and the causes of error. He cited results from different surveys, exhibited profiles, forms of notebooks employed, and speed of working. The cost of precise leveling was given at $18 to $21 per mile for field expenses. He cited a polygon of 4,000 miles in length, extending from Chicago to New York, Biloxi, New Orleans, back to Chicago, that closed with an error of one foot, and stated that bench marks had been established every 1½ miles along the Missouri River from St. Louis to Sioux City by the Missouir River Commission.

COMING TECHNICAL MEETINGS.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 10. Secy., D. W. Meeker, St. Paul.

WISCONSIN POLYTECHNIC SOCIETY.
March 13. Secy., M. F. Schinke, City Hall.

ENGINEERS' CLUB OF KANSAS CITY.
March 13. Secy., Waterman Stone, Baird Building.

ATLANTA SOCIETY OF CIVIL ENGINEERS.
March 14. S. W. Spear, E. Buffalo, N. Y., Iron Works.

NORTHWESTERN SOCIETY OF ENGINEERS.
March 14. Secy., D. W. McMorris, Burke Block, Seattle, Wash.

NORTHWEST RAILROAD CLUB.
March 14. Ryan Hotel, St. Paul. Secy., W. D. Crosman.

DENVER SOCIETY OF CIVIL ENGINEERS.
March 14. Secy., F. E. King, Jacobson Block.

BOSTON SOCIETY OF CIVIL ENGINEERS.
March 15. Secy., S. E. Tinkham, 86 Broomfield St.

ENGINEERS' CLUB OF ST. LOUIS.
March 15. Secy., Arthur Thacher, Odd Fellows' Building.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
March 15. Secy., F. Collingwood, 127 East 23d St., New York.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 15. Annual meeting. Secy., J. R. Schick, Roanoke, Va

NEW YORK RAILROAD CLUB.
March 16. Secy., H. G. Prout, 73 Broadway, N. Y.

ENGINEERS' CLUB OF CINCINNATI.
March 16. Secy., J. F. Wilson, 24 W. 4th St.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
March 16. Secy., C. F. Franson, Portland Block.

TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
March 17. 201 Washington Building.

SWEDISH ENGINEERS' CLUB.
March 18. Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.

ENGINEERS' CLUB OF PHILADELPHIA.
March 18. 1122 Girard St. Secy., L. F. Rondinella.

COLUMBIAN ENGINEERING SOCIETY.
March 21. Secy., F. W. Hart, Washington, D. C.

WESTERN RAILWAY CLUB.
March 21. Secy., C. F. Street, Rookery Building, Chicago.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
March 21. Secy., E. H. Clark, Pittsburg.

CENTRAL RAILWAY CLUB.
March 22. Secy., S. W. Spear, Buffalo, N. Y.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 24. Secy., C. H. McLeod, Montreal, P. Q.

MONTANA SOCIETY OF CIVIL ENGINEERS.
April 1. Secy., F. D. Jones, Helena.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
April 3. Secy., C. L. Annan, City Engineer's Office.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
April 4. Secy., Chas. S. Howe, Case School.

ENGINEERS' SOCIETY OF PHŒNIXVILLE.
April 4. Secy., W. Halliburton.

WESTERN SOCIETY OF ENGINEERS.
April 5. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago

ENGINEERS' CLUB OF MINNEAPOLIS.
April 6. Secy., E. Nexsen, 504 Kasota Block.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
April 7. Secy., E. K. Smoot. 808 Commerce St.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
April 7. Secy., O. Von Geldern, 719 Market St., San Francisco.

CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
April 12. Wichita, Kan.

ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
April 13. Secy., F. W. Mowbray, Norton Building.

ENGINEERING ASSOCIATION OF THE SOUTH.
April 13. Secy., O. H. Landreth, Nashville, Tenn.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 20. Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

NEW ENGLAND RAILROAD CLUB.
May 10. Secy. F. M. Curtis, O. C. R. R., Boston.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York. Entered at the Post Office, New York City, as Second Class Matter.

VOL. XXIX. THURSDAY, MARCH 9, 1893.

D. McN. STAUFFER. A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

Chicago Office: Monadnock Building.
F. A. PECKHAM .....MANAGER

EUROPEAN AGENCIES:
KEGAN PAUL, TRENCH, TRUEBNER & Co. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & Co. (Limited). St. Dunstan's House, Fetter Lane, London, Eng.

SUBSCRIPTION RATES: One year, $5.00; 6 months, $2.50; 4 months, $2.00; single copies 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. They should send both the old and the new addresses. No club rates are allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The use of intermittent filtration and broad irrigation for the purification of the sewage of Hastings, Neb., as described elsewhere in this issue, is worthy of consideration by all localities where sewage purification is needed, and especially by those cities of the West situated, as is Hastings, with no available outlet for crude sewage, either on account of the distance of streams or because of the diminished volume of the latter in dry weather. One feature of the design and management of the Hastings plant is worthy of special notice and commendation: Purification is recognized as the first object to be attained in disposing of the sewage, the raising of crops for revenue being made the second. Indeed, from the information at hand, it seems quite likely that the most profitable use of the sewage consistent with proper purification has not yet been practiced, but the sewerage system has been in use only two years, and to Jan. 1, 1893, only 119 sewer connections had been made, so that criticism on this point is hardly in order yet. If operated as designed, there seems to be no reason why an eminently successful sewage farm should not be the result. In describing the Hastings purification plant, its engineer, Mr. J. M. Wilson, of Omaha, Neb., makes some comments upon its special features, and upon general conditions affecting sewage disposal upon land, which render further discussion here unnecessary.

The development of technical societies was discussed very instructively by Mr. John Birkinbine in his address to the American Institute of Mining Engineers at the recent meeting at Montreal (Eng. News, March 2), and an abstract of this very interesting paper is given in another column. After calling attention to the growing tendency to the formation of associations of all kinds, he pointed out the great progress and achievements which have been made in engineering, and which are in a large measure due to the organization and work of the societies, bringing men together and putting them in possession of the latest and most detailed information relative to new methods, structures, machinery, etc., which information it would be practically impossible to obtain in any other way. In this view of the matter we entirely agree with Mr. Birkinbine as to the importance of technical societies, and the beneficial results which have attended the formation of such societies. The notes on the developments in mining and metallurgy which have been made during the lifetime of the institute make an interesting showing of the rapid modern development in these branches of engineering, and similar progress might be recorded of the other branches, including civil, mechanical and electrical engineering.

As to the question of the reading and discussion of papers in the limited time available at meetings, we do not think it advisable to read in full long and detailed papers, but, on the other hand, a mere brief abstract of such a paper may leave out all the pith and the salient points. Short papers may be read in full, and longer papers abstracted by the author reading certain portions from the full printed paper already distributed to members at or before the meeting. In this way they have all the matter before them, and may discuss any point, while there is ample time for such discussion. Oral discussions are very important, but should be carefully revised and corrected by the speakers before being finally printed in the society transactions, and there should undoubtedly be opportunity for both oral and written discussions in order to secure the best results. Not the least important function of the societies is the bringing together socially of engineers and members of other professions or occupations and manufacturers of materials used in engineering works, with the consequent opportunity for the interchange of views and opinions, thus broadening the minds of all concerned, and tending to the general improvement and elevation of the engineering profession. The importance of the results which have followed the formation of technical societies can hardly be overestimated, and we believe that these societies will hold a still larger part in the future progress and development of the work of the engineering and kindred professions.

The cost of fuel on electric railways was discussed in our issue of Feb. 9, and the conclusion reached was that at the present stage of electrical science the electric motor could hardly hope to compete in fuel efficiency with the steam locomotive in regular railway service. Additional evidence of the correctness of this conclusion is furnished by the experience of the City & South London Ry., which is operated under conditions approximating steam railway service more closely than any other electric railway in the world. At the meeting of the Institution of Civil Engineers on Feb. 14, a paper on the City & South London Ry. was read by Dr. Edward Hopkinson, in which a full statement was made concerning the efficiency which this system has developed. We may tabulate this as follows:

Generating dynamos, percentage of efficiency	93.4
Conductors " " "	90
Motors on locomotive " " "	70
Leakage of electric system	0.5 ampere.
Coal consumption per K.-W. hour	7.5 lbs.

While these facts are not as full as could be desired, they are sufficient to give a fair idea of what results are being attained on this road. The dynamos show an excellent record, their efficiency at full load reaching 96%, and even under service conditions the very creditable figure of 93.4% is reached. The loss due to the resistance of the conductor seems very large for a line only three miles long, but it is insignificant compared with the loss of 30% in the motor itself. The coal consumption, too, seems enormous. We are not certain where the current is measured on which the coal consumption is based, but on the most favorable assumption, that it is measured at the motor, it appears that the consumption is 8 lbs. per HP. actually exerted on the train, or 4.7 lbs. per HP. exerted on the dynamo pulley.

The reason for this heavy coal consumption was stated by Dr. Hopkinson to be the great variations in load. The average load on the central station is only about half the full load; and hence the engines are run much of the time at too light a load to work with economy. This, of course, is well known now on this side of the water; and no comparison of the electric motor and the steam locomotive is a fair one which omits or undervalues this fact.

The low percentage of efficiency of the motor on the locomotives of the City & South London Ry. is the more surprising since, so far as can be seen, the conditions are favorable for a high efficiency. The motor is mounted directly on the axles, saving the loss which occurs where motion is transmitted through one or two sets of gearing, and there are only four stops in a distance of a little over three miles. In one point, however, Messrs. Mather & Platt, the designers of the City & South London Ry., appear to deserve much credit. The total cost of repairs on the motive power plant, including central station plant and locomotives amounts to only 0.78 ct. per train mile. It is true that the plant is still nearly new, having been now two years in service, and the cost of repairs will increase as the machinery grows older. But notwithstanding this, in a plant involving so many new departures as did this, repairs during the first few years are not always measured by the natural life of the parts. The City & South London Ry. has shown an excessive fuel consumption, compared with steam railway practice, but it has also shown that where the conditions make the use of electricity advisable, it is feasible with it to handle 40-ton trains over stiff grades at speeds up to 25 miles per hour, and to do it with excellent regularity, and at a reasonable expense for operation.

The extent to which electric railways of the street railway type are taking the place of ordinary railways for short distance local lines is but little appreciated. The list of those already built and now proposed in northern Ohio alone, as given by an Ohio correspondent of the "Evening Post," who seems to be well informed, strikingly illustrates this fact. He mentions six lines of this class which have been already built, aggregating 54 miles in all (which of course is quite apart from the much longer mileage of city and suburban electric lines) as follows:

	Miles.
Canton-Massillon	9
Warren-Niles	5
Youngstown-Alliance	27
Akron-Cuyahoga Falls	4
Canal Dover-New Philadelphia	4
Wellsville-East Liverpool	5

The last named of these lines is an exceedingly heavy line, which is alleged to have cost complete $300,000, and connects two towns which never before had direct communication, owing to the hilly, broken country between them, in which 20-ft. rock cuts and 30-ft. earth cuts were demanded. In general the lines complete with equipment cost only $5,000 to $8,000 per mile. The total of lines proposed for immediate construction, some of which are under way, but some of which also, it is likely, will be abandoned or long postponed, foots up no less than 241 miles, as follows:

	Miles.
Cleveland-Willoughby	18
Akron-Canton	23
Canton-Alliance	18
Alliance-Niles	25
Akron-Cuyahoga Falls	4
Cuyahoga Falls-Ravenna	15
Tiffin-Fostoria	13
Ottawa-Findlay	86
Sandusky-Norwalk	16
Corlett Station-Chagrin Falls, etc	23
Total	241

There is something to be said both for and against lines of this character. They are usually built at the sides of highways, and the tendency will be, doubtless, to use higher speeds than are always convenient or suitable. But the gain immensely exceeds the loss. There is usually room enough; they rarely encroach on the roadway; teams will only be frightened rarely, and at first, as they are by cable cars; and a railway which carries both passengers and freight is brought to every man's door upon the line. As a whole, the movement is a good one, and likely to grow more and more important for many years to come.

UNIFORMITY IN FREIGHT CAR DRAFT GEAR.

That the railway safety appliance bill, which received the President's signature and became a law on March 3, is received with no good will by many railway officers we are well aware. The various reasons why the bill has been opposed need not be now reviewed; with all respect to the opinions held on this point by many railway officers, it is worth their notice that in one particular even the strongest opponent of the law must admit that it is designed to benefit the railways. Instead of calling it the "Compulsory Brake and Coupler Law," let us call it the "Law to Promote Uniformity in Freight Car Draft and Brake Gear."

Neglecting for the present its other provisions, let us reflect that this bill compels uniformity in

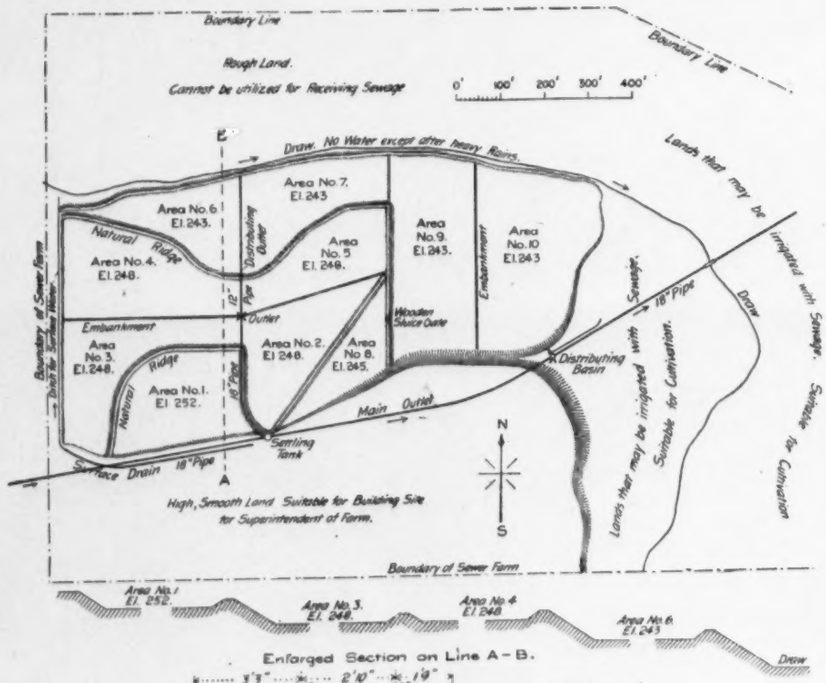
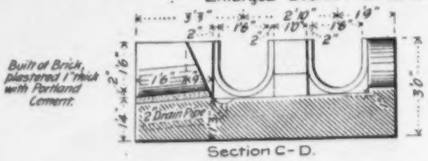

Boundary Line
Rough Land.
Cannot be utilized for Receiving Sewage
0' 100' 200' 300' 400'
Drain. No Water except after heavy Rains.
Lands that may be irrigated with Sewage.
Area No. 7. El. 243
Area No. 6. El. 243.
Area No. 5 El. 248.
Area No. 9. El. 243.
Area No. 10 El. 243
Natural Ridge
Area No. 4. El. 248.
Distributing Outlet
12" Pipe
Outlet
Embankment
Wooden Sluice Gate
Area No. 3. El. 248.
Area No. 2. El. 248.
Area No. 8. El. 245.
Distributing Basin
Area No. 1. El. 252.
18" Pipe
Main Outlet
Settling Tank
Surface Drain 18" Pipe
High, Smooth Land Suitable for Building Site for Superintendent of Farm.
Lands that may be irrigated with Sewage. Suitable for Cultivation.
Sewage for Cultivation.
Boundary of Sewer Farm
Area No. 1 El. 252.
Area No. 3. El. 248.
Area No. 4 El. 248
Area No. 6 El. 243
Enlarged Section on Line A-B.

Fig. 72. Map of Disposal Area.



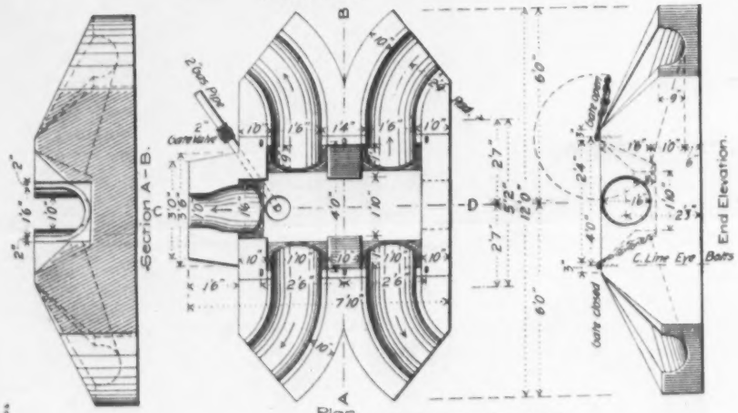
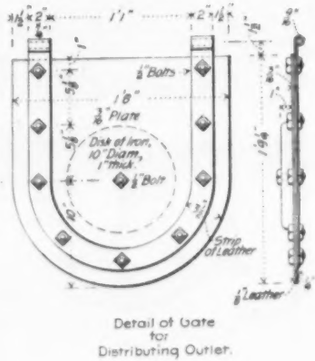


Fig. 74. Four-Way Outlet.



Detail of Gate for Distributing Outlet.

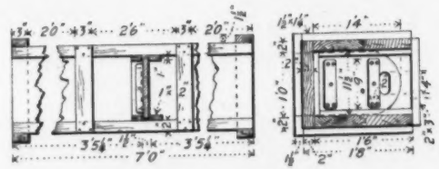
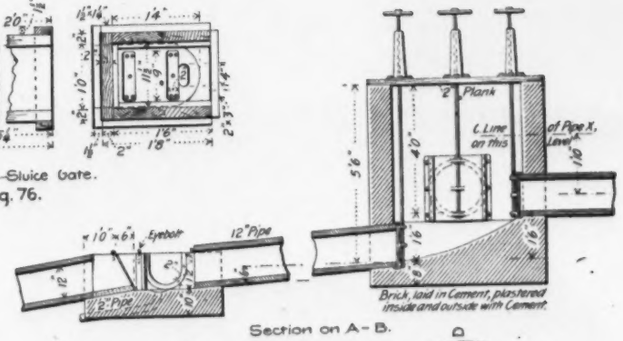
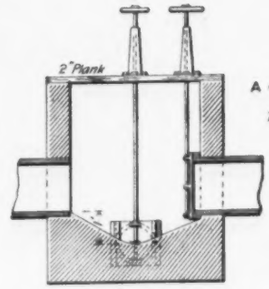


Fig. 76.



Section on A-B.



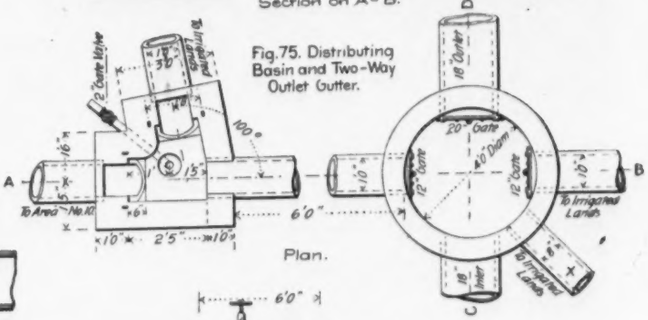


Fig. 75. Distributing Basin and Two-Way Outlet Gutter.

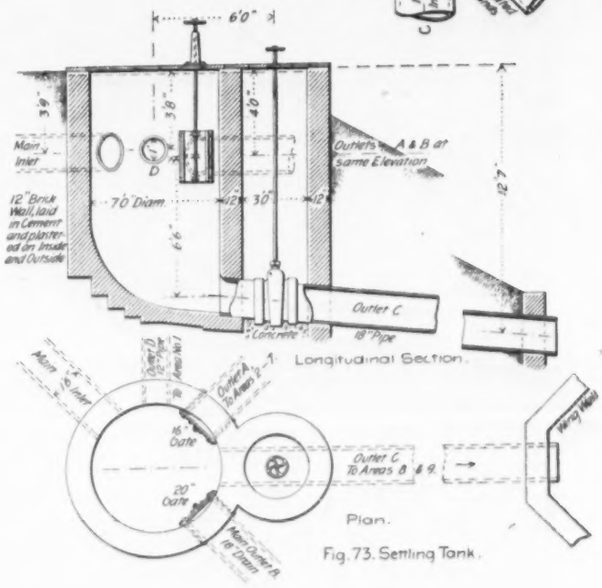


Fig. 73. Settling Tank.

The Sewage Purification Plant, Hastings, Neb.

J. M. Wilson, Engineer.

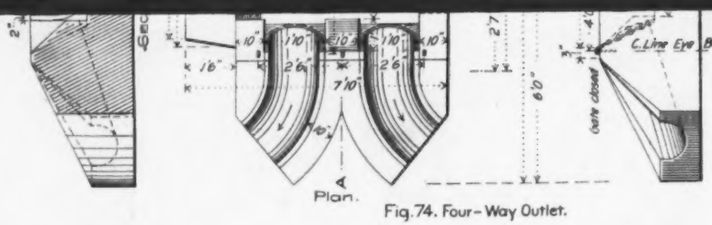
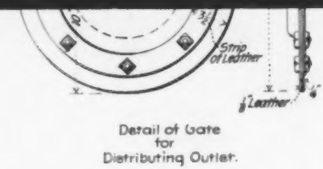


Fig. 74. Four-Way Outlet.



Detail of Gate for Distributing Outlet.

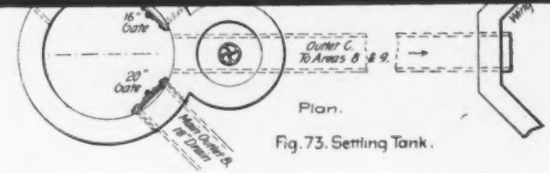


Fig. 73. Settling Tank.

The Sewage Purification Plant, Hastings, Neb.

J. M. Wilson, Engineer.

Supplement to Engineering News, March 9, 1893.

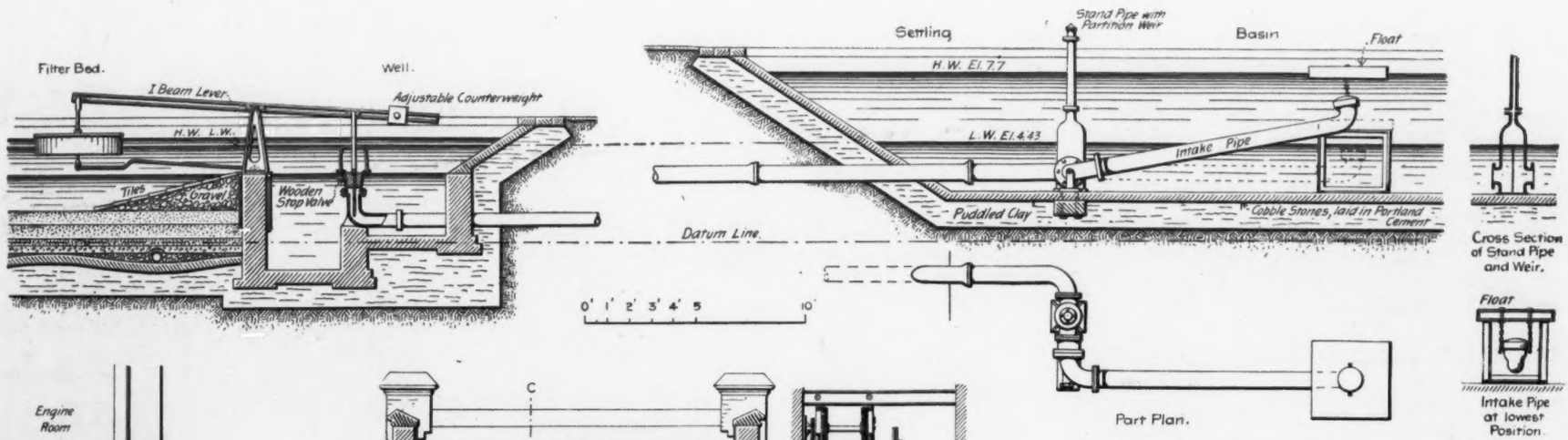
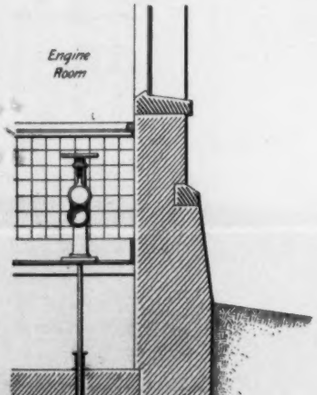
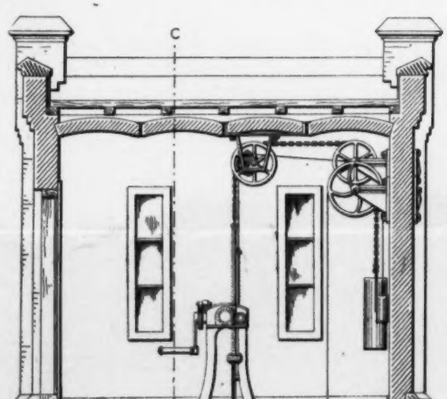
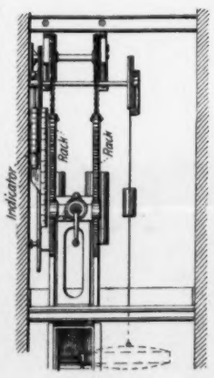


Fig. 1. Longitudinal Section of Settling Basin and Filter Bed.







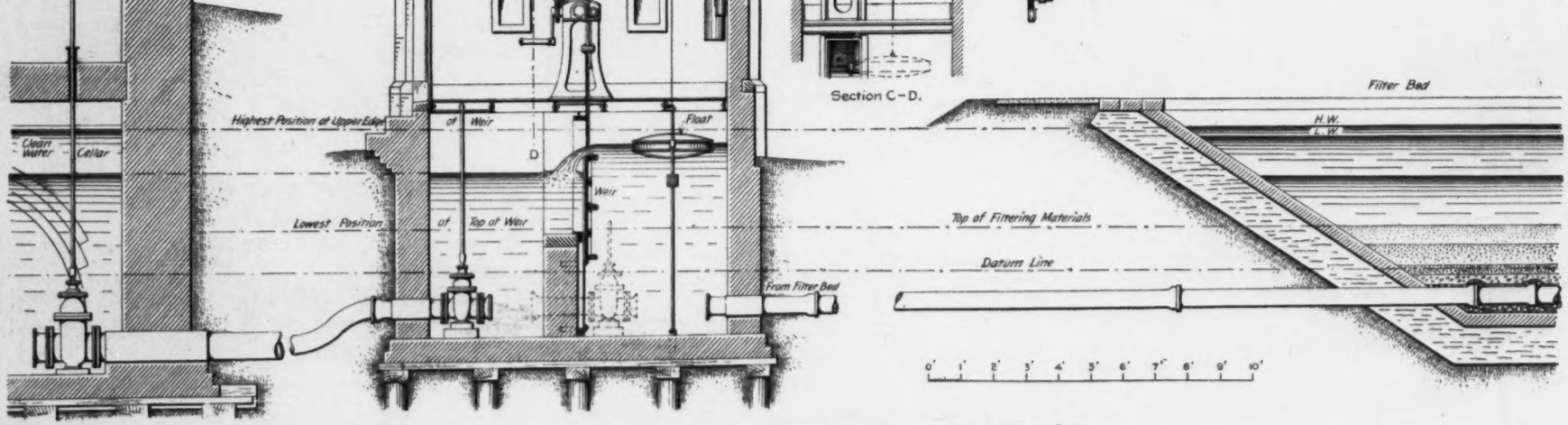


Fig. 2. Section through Clear Water Reservoir, Regulating Chamber and Filter Bed.

The Water Filtration Plant at Leeuwarden, Holland.

H. P. N. Halbertsma, Engineer.

height of drawbars, and practically compels uniformity in brakes and couplers. Every one must concede that uniformity in these matters is a necessity, and ought to have been brought about by the railways themselves without the action of Congress. It may be said truly that it has been brought about already in some measure; but in what a piecemeal and fragmentary way. How many roads are there still which coolly ignore all the standards of the M. C. B. Association, adopt them if it suits their pleasure, reject them if it does not? Even the Rules of Interchange, which are often referred to as the strongest weapon for compelling uniformity, have to go down when they conflict too severely with the interests of the traffic department.

Really, when one stops to think of it, what an anomaly it is that roads should go on building freight cars with very little more regard for uniformity than is paid in the case of passenger cars. If a standard of the M. C. B. Association interferes with a pet idea of some officer in authority, the pet idea wins the day every time. Yet these cars are to go out all over the country, and but a small part of their travels will be on their home road. In fact, it has been well shown that to this very lack of uniformity a large part of the fatalities in car coupling are due. It is quite possible that if no longer than 15 years ago the railways had adopted a standard height of drawbar, a standard link and pin draw-head, standard grab-irons and steps, and had faithfully followed these standards, the present law would not now be in force.

But taking matters as they stand now, is it not plain enough that uniformity, not only in the matters prescribed by the law, but in the whole freight car draft gear, ought to be brought about. Since the couplers must be adjusted in height where necessary to meet the new standard, and automatic couplers must replace the link-and-pin drawbars, is it not worth while to make a clean job of the whole, so that when the time fixed by law expires we shall have all cars fitted with uniform draft gear? Let us consider the chief matters on which uniformity is essential or desirable:

Height of Draw-bar.—The investigations of a committee, which reported at the Saratoga convention last summer, showed that the standard height of 33 ins. from rail to center of draw-bar was followed by 54% of the roads reporting, while 46% have standards of 34½ to 35 ins. The committee which will report at the present convention, of which Mr. E. D. Nelson, of Williamsport, Pa., is chairman, has just issued a circular, asking for further information on the subject. The tendency seems to be toward an increase of the draw-bar height, and it is not unlikely that the height adopted for new, empty cars may be made the same as the passenger standard, 35 ins. This would facilitate coupling passenger and freight cars in mixed trains, and would also favor the plan practiced on the Chicago, Burlington & Quincy of dispensing with draft timbers, as shown on the standard 60,000-lb. coal car of that road in another column of this issue, and on the standard 50,000-lb. furniture car illustrated and described in our issue of Feb. 23.

Draw-bars.—The tendency to variation from the M. C. B. standard contour lines, which was quite serious two years ago, has disappeared, and the variations in the coupler which now cause chief trouble are variations in unlocking gear and the unimportant variations made by the different manufacturers. The M. C. B. committee on this subject recommended last year the adoption of a standard unlocking gear, and the need of action on this point grows more evident with time. A brakeman, while unlocking a coupler, has no time for a diagnosis to determine whether a push down, a pull up or a turn to the right or left is the proper motion. If the handle refuses to move, he does not know whether it is because the lock binds, or because he is pulling in the wrong direction. The matter of automatic opening of the knuckle or opening by the unlocking gear also deserves consideration. There are strong reasons in favor of the automatic opening, and its importance for the protection of the coupler is probably greater even than for the protection of the trainman. If it can be secured without too much cost and complication, it ought to be done.

The question of questions concerning couplers has been the matter of strength and durability. The investigations of the M. C. B. committee on this subject have been of great value, and their standard specification is destined, doubtless, to more and more extensive use. No action seems to be necessary by the Association to bring about the uniform adoption of this or any other standard of strength, for experience will soon teach railways the folly of purchasing anything but the strongest couplers.

A knotty question which must be met, however, is the expense and annoyance due to the great and increasing variety of draw-bars and knuckles in service. It cannot be expected that every railway will carry, at every point where running repairs are made, a stock of knuckles of every make on the market: neither can the expense and delay of holding every car with a broken knuckle until a new one can be secured from the manufacturers be endured. The running of the M. C. B. draw-head without its knuckle coupled to a common draw-head is claimed to cause a contest in which the link-and-pin drawhead usually comes off second best.

Prominent railway officers have proposed to solve this whole difficulty by requiring absolute uniformity, so that the knuckles of any coupler maker will fit any other maker's drawbar. If this remedy is too radical a one, we know of no better plan than that suggested in this journal some time ago to require all coupler makers, except the four or five which have the greatest number in service, to attach a spare knuckle to every car equipped, for use in repairs.

Draw-bar Attachments.—The old standards for attachments of link-and-pin draw-bars are practically a dead letter. In the attachments of the M. C. B. bar, at its rear end, practice is divided between the tail bolt and the yoke, the former being the favorite in the East, and the latter in the West.

As respects their relative merits, there is no question, we believe, that the tail bolt is the easier and cheaper to put in place and repair. It's unpopularity with the Western roads is doubtless due to the numerous failures which have taken place; but there is no reason on the face of things why a tail bolt should not be made strong enough to stand any strain which the draw-bar can stand. A 2¼-in. rod has a gross section of nearly 4 sq. ins., and ought to stand at least 50,000 lbs. per square inch. If this is not enough, an increase of only ¼ in. diameter increases the section to 5 sq. ins., which certainly ought to suffice. It is true that 2¼-in. tail bolts have broken in many cases; but the fault appears to have been due not to insufficiency of section, but to metal poor or poorly worked, or connected to the draw-bar in an inefficient manner. Apparently the Western roads will have to bring a stronger indictment against the tail bolt before the Eastern roads will discard it.

Closely connected with this is the matter of safeguards to prevent draw bars or their heads from falling on the track in case of fracture. If this is important enough to warrant it, the best way ought to be found out and made standard. This is a matter which affects the railways as a whole much more than it does any single railway. To make this still plainer, if a company's cars make one-third their mileage on the home road, then for every thousand dollars paid for safety devices of this sort two-thirds goes entirely to benefit other railways. Hence, if this safeguard ought to be put on at all, it ought, in fairness, to be placed on all cars.

As for other attachments to the draw-bar itself, such as follower plates, springs, continuous draft rigging, and devices for holding the bar in the center of the carrier iron, while uniformity is not essential its advantages in cheapening and facilitating repairs are universally conceded, and while the draft gear is being overhauled, these might as well be taken up and made standard, if within the limits of possibility.

Dead-Blocks.—These are really a part of the draft gear and deserve consideration with it. The arguments for and against them have been recently aired in the railway club discussions (Eng. News, Jan. 26 and Feb. 23). The facts brought out in these discussions are about as follows: The principal Eastern roads have long used double dead-blocks, and the Western roads have neglected them. Recently some of the Eastern roads have abandoned the use of dead-blocks and some of the Western roads have begun to apply them.

It is not easy to see what reasons have led the Eastern roads, after many years' use and advocacy of dead-blocks, to remove them. The dead-blocks have been called "man-killers," and it is undoubtedly true that in making a link and pin coupling, fingers and arms are liable to be caught between the dead-heads. On the other hand, the danger of the end sills coming together and crushing a man's body in case the draft gear or the coupler fails under the shock of buffing is much greater if the dead-blocks are omitted. At present the dangers arising from the use of dead-blocks are aggravated, and the safety against crushing between the cars is diminished by the fact that a large number of cars are unprovided with dead-blocks, and even where they are applied, the M. C. B. standards for position and size are wholly disregarded. A yardman who steps in to make a coupling by the dim light of an oil lantern can see perhaps the shape of the dead-blocks—if there are any—on the car by which he stands; but he has no time to see what shape and size of dead-blocks may be on the approaching car. His attention must be concentrated on guiding the link. It is little wonder under these circumstances that dead-blocks have earned a bad name among trainmen, notwithstanding the protection they offer against death by crushing. It seems to be this bad name more than anything else which has prevented the use of dead-blocks on the Western roads.

It must be remembered, however, that the question whether dead-blocks are a protection to the brakeman is essentially a temporary one. In a few years all cars will be equipped with automatic couplers, and it will no longer be necessary for a man to stand between the cars as they collide in order to make the coupling.

Looking then to the future, the question to be settled is whether the dead-blocks should be put on as a protection to the M. C. B. coupler. Here the evidence seems overwhelming in favor of the dead-blocks. The strains of buffing are already the most severe which the draft gear has to sustain. What will they be when switch enginemen can push down a long train to couple up, and are no longer under the restraint due to the knowledge that one of the trainmen is standing between the cars? Suppose the draw-bar and its attachments can be made strong enough to stand these shocks, can they be transmitted to the floor of the car without destroying the draft timbers? Is it not much more sensible to transmit this buffing shock directly to the car floor by dead-blocks on the end sill, than to transmit it through parts which should not be called upon to bear the strain?

It is argued by some that the dead-blocks interfere with coupling on sharp curves, but this is met by the statement of those who use dead-blocks that they find no difficulty in coupling on curves. Apparently this is a difficulty which will only be encountered on very sharp curves on cars with weak or broken draft springs. Unless some better evidence is given in its support than has yet appeared, it is not a valid reason for discarding dead-blocks.

The discussion which has already taken place has emphasized the need of the adoption and observance of rigid standards for dead-blocks. With the present lack of uniformity, a large part of the possible gain from the use of dead-blocks is not realized. The variations from a square and even meeting will be great enough, even when all cars are equipped with dead-blocks of uniform pattern and when standards for their position are rigidly adhered to. Differences in height of loaded and unloaded, old and new cars will be sufficient to give very one-sided blows when the dead-blocks come together.

Grab-Irons.—The law just enacted requires that within 28 months from this date all cars must be provided with "secure grab-irons on the ends and sides of each car." The size and location of these are left to the railways to determine, but it is self-evident that a great part of the gain to be derived from them will be lost if every road puts them on as it pleases.

Trainmen can work at night with comparative safety, if they know just where foot or hand can find a secure hold on the end of every car. It costs no more to make the location of such safeguards uniform than to put them on here, there

and everywhere, as pleases the whim of the officer who happens to be in charge of car construction when the cars are built. It is a regrettable fact that previous attempts at uniformity in this matter have failed. The M. C. B. standards for the protection of trainmen from accidents, adopted in 1879, are followed by only two roads, and only three roads came anywhere near observing the requirements.

All the subjects which we have discussed above, with the exception of dead-blocks, are in the hands of committees which will report at the next convention of the Master Car Builders' Association. It is to be hoped that their reports may put the matter of uniform freight car draft gear in such shape that the Association will ratify it; and that once adopted, it may receive the universal adherence of the railways. It is they whose interests are at stake, and it is they who have been most injured by the diversity in practice which has prevailed in the past.

THE TENDENCY OF POPULATION INTO CITIES.

A recent census bulletin (No. 165) gives a return of much interest which has never been embodied in any prior census, viz.: one giving for the whole United States, and for each of the five main groups into which the census divides the United States, the total urban population in towns between the limits of 1,000, 1,500, 2,000, 2,500, 3,000, 4,000, 5,000, 6,000, 8,000, 10,000, 15,000, 25,000, 50,000, 100,000, 400,000 and over 400,000. A prior bulletin (No. 52) gave the urban population in cities of 8,000 inhabitants or over, but as each country, with which it might be desirable to compare our own statistics, has a different standard of "urban" population, and as a different limit is desirable for almost every different purpose to which statistics of cities can be put, the value and convenience of this table is evident.

Unfortunately, it is not possible to determine the rate of growth of each of these classes of cities and towns, because similar tables were not compiled for 1880 for towns of less than 4,000 people; but enough was given in 1880 to indicate tendencies by comparison with 1890.

The better to enable us to see what the figures mean, we have deduced corresponding figures, so far as possible, from the 1891 census of Canada, England and Wales, Scotland and Ireland. The Canadian returns for the towns were the first returns compiled for its 1891 census, for the apparent reason that they alone showed an increase of population, the rural population of Canada having remained almost stationary, as we showed more fully in our issues of Nov. 14 and Dec. 26, 1891. A list of all the towns (47) having a population of 5,000 or over is given with the corresponding population in 1881, and the total "urban" population, by which term in Canada is understood all towns or villages of over 1,500 inhabitants; but although the percentage of increase is given for towns of over 5,000, 3,000 to 5,000, and 1,500 to 3,000 total population, the actual figures are not given either for 1881 or 1891.

The British returns are very curious in this; the returns for England, Scotland and Ireland are not only different in form but in their substance, and in the form in which returns common to all three are presented. Those for England are systematic and detailed. Everything which under the law is a "Sanitary District" is called urban, 195 out of 1,006 having a population below 3,000, but no fixed minor limit is set. They are tabulated between the limits of 3,000, 10,000, 20,000, 50,000, 100,000, 250,000 and above the latter.

In Scotland there is this totally different and very odd system: The population is divided by the Registrar-General into five groups, Principal Town Districts, Large Town Districts, Small Town Districts, Mainland Rural Districts and Insular Rural Districts. No basis for the sub-division is stated, or appears to have existed, except the judgment of the Registrar-General. The population, number of houses, number of rooms with more than one window, etc., are given for each of the nine "principal towns" only, the smallest being of 28,000 population, against a 50,000 limit in the English return.

The Irish return is still more oddly different from both the Scotch and English. It covers only 22 pages, and is largely devoted to religious statistics, which do not appear at all in the other two returns. There is, however, a table purporting to "show (1) the towns having in 1881 a population of 10,000 or over; (2) the parliamentary boroughs; and (3) the suburban townships of Dublin." There are, however, at least four towns* in the brief list of 29 which have neither 10,000 population, nor are they parliamentary boroughs, nor are they (at least one or two of them which we have found upon the map) suburbs of Dublin. The list is classified, moreover, not in order of population, but in order of percentage of increase or decrease since 1881.

We have struck no odder example of some deep-seated differences between British and American methods of government than this. The British census is a "photographic" one taken in a day as for a single night, and counting each person where he happens to sleep on that night. Ours is taken through a whole month, and counts each person at his permanent home. Remembering also the small size of Great Britain in comparison with our own vast and still only partially settled domain, throughout all of which absolute identity of method obtains, one would think that it would be instinctive to make the forms for the British returns also uniform for England, Scotland and Ireland. Yet here are three returns differing in form and substance as much as either can differ from that of any foreign country! About the only fact which these returns agree in giving is the total population; and that is carried back to 1801 in the English returns, to 1841 in the Irish returns, and only to 1881 in the Scotch returns!!

Grappling with these difficulties as well as we could, we have compiled and computed the accompanying Table I., showing the percentage of the total population of 1890 (or 1891) living in cities exceeding certain sizes. Subtracting any one of these percentages from another, we have of course the percentage of the total population living in cities between certain sizes. Arranging the several sections of the United States and Great Britain in the order of the percentage of population in large cities we obtain the comparison given in Table II.

The extremely small rural population of England, Scotland and our own North Atlantic States is a most remarkable evidence of the rapid concentration into cities which has been going on for half a century or more, and which has not yet stopped, though it is evident that the natural limit has been very nearly reached beyond which population cannot be drawn from the country without leaving it depopulated, so that the cities can only continue to grow by drawing upon each other. Already 26% only of the population of England (some 7,540,000 in all) lives in the country or in villages of less than 1,000 population. The rural population is now somewhat less than it was 40 years before, in 1851, during which time the urban population has increased from 9 to nearly 21 millions.

The population of London alone, not including its ring of suburbs, is 14½% of the total population of England and Wales, or about the same as it was 20 years ago. In 1801 it was barely 10.8%, and during the 70 succeeding years gradually gained upon the country in the light ratio named, which means that the smaller cities have been proportionately gaining on London. While Inner or Registration London increased only 10½% in the past decade to 4,211,056, however, the "Outer Ring" increased 49½% to 1,422,276, making the population of the metropolis 5,633,332. Metropolitan New York, which is now well ahead of Paris, has but little more than half this, and yet it is notable that our North Central States are already but little behind England and Wales in proportion of population in large cities.

Of course it is impossible for such a disproportion of city residents to exist in strictly self-supporting districts. If England or our Northeastern States had to feed themselves from their own farms there would speedily be a decrease of town population, and yet the United States, as a whole, is much more than self-supporting, and it has only 58.3% of its population on farms and in small villages, no less than 41.7% living in towns of 1,000 or over. We may say roughly that the United States and Great Britain together are just about self-supporting as respects food supply, and hence together represent just about what proportion of an energetic and highly civilized population must live in the country in the existing state of the arts, in order to produce the necessary food supply. Their aggregate population is now about 100,362,000, of which an even 52,000,000 (as nearly as may be) live in towns of 1,000 or over, the remaining 48,362,000 being a rural and small village population. Until agriculture has been so improved, by the aid of electric power or otherwise, that one man's labor on a farm will produce much more than it does now, this would appear to be the limit of increase in urban population for a self-supporting nation, from which it logically follows that when the United States has reached a population of 100,000,000, say, in 1910, it will have ceased to be a food-exporting nation; for our town population, which is already about 36,400,000, will then far exceed 52,000,000 at present rates of growth. We have no idea that the United States will cease to be a food-exporting nation, however, then or for a century to come, for the reason that the product of one man's labor on the farm is constantly increasing, and will increase by increasing use of machinery.

If people would only look at these phenomena of city growth in a large way they would see at once its nature and limits. It is idle to rail against it as an evil of our civilization, or as threatening civilization, as is often done. The main fact that it has gone on and that it will go on up to a certain limit and no farther is easily seen in this way:

All men in all ranks of life who have to choose absolutely between the two prefer city life to country life, barring a small percentage. The

Table I. Percentage of Total Population living in Cities of Certain Sizes or Over—in the United States and Interior Groups thereof, Canada, England, Scotland and Ireland.

	U. S.	Atl.	No. Cent.	So. Atl.	So. Cent.	W. & Pacif.	Canada.	Eng. & Wales.	Scotland.	Ireland
100,000 and over	15.5	22.9	14.3	7.5	3.6	13.4	8.2	31.6	27.4	10.9
25,000 " "	22.4	41.0	19.0	12.1	7.5	23.2	14.2	....	33.8	18.2
10,000 " "	27.9	49.4	24 6	15.4	9 9	29.7	17.1	61.4	....	22.7
8,000 " "	29.2	51.8	25.9	16.1	10.4	30.0	19.0	....	....	....
5,000 " "	31.8	56.0	28.8	17.0	11.6	32.6	21 3	....	....	....
3,000 " "	35.0	60.7	32.1	18.6	13.2	36.5	....	70 4	....	....
1,500 " "	39.4	66.8	36.4	21.2	16.1	42.4	28.8	71.7†	71.8	....
1,000 " "	41.7	70.0	38.9	22 2	17.4	44.9	} 71.2	} 28.3	....	....
Rural	58 3	30 0	61.1	77.8	82.6	55.1			28 2	....
Total population, 1-1,0°0	62 62?	17,402	22,362	8,858	10,973	3,028	4,829	29,001	4,033	4.706

Table II.

Per cent. of total population of 1890-91 in cities of	Over 100,000.	Over 10,000.	Over 3,000.
England	31.6	61.4	70.4
No. Atlantic group	28.9	49.4	60.7
Scotland	27.4	40. (est.)	65. (est.)
No Central group	14.3	24.6	32.1
Wes'. (Pacific) group	13.4	29.7	36.5
Ireland	10.9	22.7	(?)
Canada	8.2	17.1	25. (est.)
South Atlantic group	7.5	15.4	18.6
South Central group.	3.6	9.9	13.2

[The estimates given in this table can be checked by Table I.]

It will be observed that our North Atlantic group (New England and Middle States) is now in almost precisely the same condition as England and Scotland as respects proportion of city population. Our North Central and Pacific groups are also in almost precisely the same condition, and with but a little larger ratio of city population than Ireland. Canada compares quite closely with our South Atlantic group and our South Central group, and is still almost exclusively agricultural.

Working backward now, to compare the rural populations, we may deduce from Table I. the following Table III.:

Table III.

Per cent. of total population (90-91) living in country or in towns of less than	1,000 pop.	1,500 pop.	3,000 pop.
South Central group.	82.6	83 9	86 8
" Atlantic "	77.8	78 8	81.4
Canada	70. (est.)	71.2	75. (est.)
North Central group.	61.1	63.6	67.9
West (Pacific) "	55.1	57.7	63.5
Ireland	(unknown)	....	....
North Atlantic	30 0	33.2	39.3
Scotland	28.2	(unknown)	
England	26. (est.)	29.6	23.3

* Drumcondra (4,878 population), Clontarf (4,210), New Kilmainham (5,391), and Blackrock (8,902).

wealthy few can divide their time between the two, and enjoy the delights of both, but these are too few to count. Also, the great staples of food only are produced exclusively or best in the country. All other articles of human desire, including minerals, factory products and "fancy" articles of food, are produced best in cities and towns. Now, the demand for the heavier food products is strictly limited. Be a man ever so rich, he only wants so much of them. The demand for the higher luxuries of civilization, its "fancy products," so to speak, is absolutely unlimited; be a man ever so rich, he never has quite enough of them, and is always buying more. Therefore, taking the civilized world as a whole, there is no expanding market for heavy food products. Any excess above the current demand immediately results in a large fall of prices, makes agriculture less lucrative, and drives (or rather, permits) an increasing multitude to go into the town and city trades, which minister to man's love of luxury. Let too many give up food production and its price will rise while other prices fall, and many will be forced back into agriculture, but the condition of stable equilibrium for the world's civilized population is that just enough "farm it" to feed the whole, and all the rest turn their attention to producing luxuries for the farmers and their middlemen and for those engaged in transportation and professional service. Of course the farmers will farm where they can farm to most profit, and therefore, so long as the English manufacturer can produce salable articles, while the English farmer cannot compete with our great West, there will be an excess of agricultural products in this country which will be exported to England. No legislation can possibly change this law. The Englishman must and will have this food, and he must and will pay us or some other country enough to cause us to produce this excess for his use. Therefore, there is a limit, which is not far off, to the relative growth of our city population. But for agricultural machinery it would be far less than it is. With much more perfect agricultural machinery, but never otherwise, it may be relatively much greater than it is.

A steam towing machine has been brought out by the American Ship Windlass Co., of Providence, R. I. The hawser is wound on a drum connected by gearing to a two-cylinder hoisting engine. When the strain on the hawser exceeds the force due to the pressure in the cylinders the hawser is paid out, and when the strain is relieved the hawser is wound in. A reducing valve automatically regulates the pressure in the steam cylinders, decreasing it as the hawser is drawn in and increasing it as it is paid out, so that the length of rope between the two vessels remains constant. By disconnecting the reducing valve apparatus the machine becomes a simple winding engine and winds the hawser on the drum when it is cast off. Some such apparatus is a necessity for the safe towing of a large vessel in a heavy sea.

A new rapid-fire gun has been invented by Mr. Charles W. Sponsel, of Hartford, and long engaged in the manufacture of Hotchkiss guns at the works of Pratt & Whitney. The Sponsel gun has but 20 pieces, as compared with 32 in the Hotchkiss and 52 in the Driggs-Schroeder. It is to be tested by the Navy Department. In a preliminary test by Lieutenant Eames, Inspector of Naval Ordnance at the works of Pratt & Whitney, that officer says it will be a formidable rival to its two American competitors, and to the best guns abroad. It is cheap, easily loaded, has large clearance for dirt, is taken apart in a few seconds, has no screws in the breech mechanism, all working springs are spiral, and no tools are required for dismounting or assembling the breech mechanism.

The $1,500,000 claim of Mr. John E. Du Bois against the Brooklyn Bridge, for infringement of his patent for caissons, has been disallowed by the referees appointed for toying his claim, under an act of the legislature. Mr. Du Bois commenced his suit in 1888. The referees admit the granting of a patent to Du Bois, but aver that his patent was obtained surreptitiously for a device really invented by Geo. A. Parker, the engineer of the Havre-de-Grace Bridge built over the Susquehanna, in 1867. The answer also shows that the caisson had been previously used by many American engineers, and was described in engineering works in 1847.

A highway bridge across the tracks at Bridge St., Amsterdam, N. Y., is to be built by the New York Central & Hudson River R. R., in order to abolish the present grade crossing, which is the only one within the city limits.

LETTERS TO THE EDITOR.

THE ACTUAL RESISTANCE OF BEARING PILES.

Sir: Your article on "The Actual Resistance of Bearing Piles," in the News of 23d inst., conveys so erroneous a conception of our formula that I find myself reluctantly compelled to appear again in print upon this subject.

The most serious matter in your presentation of our formula in the article referred to is the implication that the formula leaves the engineer, in any given case, with no more definite instructions than that the safe load is to be taken at from one-half to one-twelfth of the extreme load, as given by our formula.

Our factor of safety does, indeed, range from one-half to one-twelfth, as stated briefly in several places in my discussion of Mr. Crowell's paper, but that the implication referred to is utterly misleading will appear at once from the fact that our rule (Pocket Book, page 644) reads:

As to the proper load for safety, we think that not more than one-half the extreme load given by our rule should be taken for piles thoroughly driven in firm soils; nor more than one-sixth when in river mud or marsh. If liable to tremors, take only half these loads.

Now, in any given case the engineer knows whether the bottom is of "firm soil" or of river mud or marsh," and whether the structure is such that the piles will or will not be "liable to tremors." Hence our rule gives a set of maximum factors of safety as follows:

	If not liable to tremors.	If liable to tremors.
Firm soils	one-half	one-fourth
River mud or marsh	one-sixth	one-twelfth

from which one factor is to be selected for any given case, and in accordance with the peculiarities of that case.

In the face of this to intimate, as you now do, that our rule says simply "for safety take anywhere from one-half to one-twelfth of the extreme load given by the formula" is as grotesque a misrepresentation as it would be to take a case where the fall h is stated as "somewhere between 5 and 30 ft.," and argue that your formula was of no use because it gave loads varying from L to 6L; while to make it appear, as does your table on page 171, that our formula, FOR A GIVEN CHARACTER OF SOIL, gives results varying from one-half to one-twelfth of the extreme load is as unjust as it would be to take a case with a fall of 10 ft., and claim that your formula gives for that case results varying from L to 10L because it is intended for heights of fall of, say, from 3 to 30 ft.

I therefore beg to submit, as below, a version of this table, in which the safe loads given by our formula are stated as the wording of our rule requires, taking occasion, at the same time, to rectify a scarcely less glaring oversight on your part in classing extreme loads and safe loads without distinction under the common head of "actual loads," as well as to correct a few small errors in your calculation, and one or two greater ones in your statement of the data.

Treated justly, as above, our formula will be seen to compare favorably (as far as these few records can show) with one which is claimed to be "in all cases a safe guide."

Noting your remark that the foregoing seven cases, "which are given in Trautwine's 'Pocket Book,' are in addition to the following list" of 17 cases taken from my discussion of Mr. Crowell's paper, I may remark, as stated on page 147 of the discussion, that the latter were restricted chiefly to those results "which give, or from which we may infer, the ultimate or extreme load," that hence the first four and the last one of the seven results which you now quote, giving, as they do, only the safe load, were necessarily omitted from the list given in the discussion, while the fifth and sixth, which give the extreme load, are included in that list, forming cases 2 and 6 (Philadelphia and Pensacola), respectively.

There is another point in your article to which I must refer, and that is your summing up of the results of the comparison, in my discussion, between the actual results collated and the loads obtained from the three formulas. I give these results below, and repeat, as stated on page 153 of my discussion, that "the first eight may be considered good cases; the conditions of driving and loading correspond with what may be called ordinary practice, and in most of these cases are stated with reasonable clearness." The other nine cases are much less reliable. (We give only the first eight to save space and time.—Ed.).

In this comparison:

R = the actual extreme load on one pile.

R_w = the extreme load on one pile by the Engineering News formula.

R_t = the extreme load on one pile by the Trautwine formula; and, inasmuch as the quotients given are the ratio of the loads by the formulas to the actual loads, the approximation of the formulas as to these results is closest when the quotient approaches most nearly to unity.

A.—Piles tested by loading.

Case No.	$\frac{R}{R_w}$	$\frac{R}{R_t}$
1	1.320	0.798
	1.321	1.439
2	0.400	1.047
	0.554	1.450
	0.924	2.415
3	0.187	0.383
	0.136	0.315
4	0.263	0.541
5	0.693	0.549
6	1.545	1.084
7	0.284	0.643
	0.378	0.857
	0.567	1.285
8	0.278	0.644
	0.333	0.772
	0.926	0.462
	1.111	0.555
Mean	0.699	0.896
Maximum	1.545	2.415
Minimum	0.136	0.315

As I have already stated, I do not consider the evidence of these cases sufficient either to establish or to condemn any formula; but they are all that I could find, and, taking them for what they are worth, and bearing in mind the greater reliability of the first eight cases, I had flattered myself (though modesty, of course, constrained me to leave it for you and for others to note and proclaim the fact) that the result of this comparison was distinctly favorable to our formula, and I am naturally surprised, therefore, to learn from you that it "clearly shows that the Engineering News formula gives the closest approximation of the three."

John C. Trautwine, Jr.

(The reason why we took an unfavorable view of the comparative results of the Trautwine formula can be very briefly, and we think conclusively, shown from the eight instances referred to, by comparing the SAFE loads which the two formulas give, using Mr. Trautwine's own factors, as follows:

Instance.	By Trautwine formula. Conditions.	Factor.	Mean ratio of formula safe load to bearing, power by test. Trautwine.	Eng. News.
1	Mud, tremors.	1-12	.086	.22
2	Mud, tremors.	1-12	.14	.10
3	Mud, tremors.	1-12	.021	.025
4	Mud, no tremors.	1-6	.09	.04
5	Mud, no tremors.	1-6	.045	.12
6	Mud (f), no tremors.	1-6	.09	.26
7	Sand, tremors.	1-4	.23	.07
8	Sand, no tremors.	1-2	.30	.11
Mean			.121	.118

	Soil.	Weight of ram, pounds. W.	Height of fall, feet. h.	Penetration, inches. s.	Actual load, pounds. Extreme.	Actual load, pounds. Safe.	Loads by formulas, pounds. Engineering News. Safe load = $\frac{2wh}{s+1}$	Trautwine. Extreme = $\frac{50w+3vh}{s+1}$	Maximum factor of safety. Steady	Maximum factor of safety. Tremors.	Maximum safe load. Steady	Maximum safe load. Tremors.
Chestnut St. Brid'e, Phila.	River mud	1,200	20	0.75	.....	40,300	27,430	93,100	¼	1/12	15,500	7,750
Neuilly Bridge	Gravel	2,000	5	0.016	.....	105,300	19,685	168,300	1/6	⅛	84,150	42,075
Hull Docks	Mud	1,500	24	2.00	...	45,000 to 56,000	24,000	72,150	¼	1/12	12,000	6,000
Royal Border Bridge	Sand and gravel	1,700	18	0.05	.....	156,800	51,800	204,000	1/6	⅛	102,000	51,000
Philadelphia, 1873	Soft river mud	1,600	36	18.00	14,560 to 20,362	.....	6,060	13,930	¼	1/12	2,320	1,160
Pensacola (U.S. trial pile)	Silt, sand and clay.	910	5	0.375	59,600	.....	6,620	56,600	1/6	1/12	28,300	14,150
French rule	Not stated	1,344	4	0.013	.....	56,000	10,610	105,200	Given data insufficient.			

The face of these returns looks as if the two formulas were much of a muchness, but let us look further. The three instances in which it looks as if the safe load by the Engineering News formula was decidedly too low are Nos. 4, 7 and 8, yet in all three of these instances the full data, as abstracted in our issue of Feb. 23, show that, as a matter of fact, the Engineering News formula gives as great a safe load as is warranted. In case No. 4 piles settled under 44,800 lbs. and the formula gives 28,333 lbs. safe load. In case No. 7 piles settled under 75,000 lbs. and the formula safe load is 44,080 lbs. In case No. 8, the formula gives just half the estimated extreme supporting power. Therefore, in these three instances, the Trautwine formula appears to give a greater load than is really safe.

We may or may not have been right in thus reasoning from these particular records, but as Mr. Trautwine himself admits that his formula is not consistent under extreme cases of fall, giving far too high values for low falls and vice versa, owing to its making the bearing power vary with the cube root of the fall, we fail to see why he should so strenuously insist that the formula chances to fit certain particular instances as well or better than others, even if it did so. Supposing this absolutely proven; what then? It is known that in certain other cases it would not be so trustworthy. The Trautwine formula would naturally fit the seven instances quoted from the Pocket-Book pretty well, since it was framed to fit those instances only or chiefly. It is not probable that Mr. Trautwine framed it to fit any other specific records, or he would have quoted them.

As for the Trautwine factors of safety, it seems to us absurd to maintain that the intent of the sentence quoted is to give four specific factors to be used in four specific instances. The factor it specifies in effect is "from 1-2 to 1-6, but only half as much if liable to tremors." What structure was ever built that was not "liable to tremors," if only from earthquakes? Practically, the specification is for a factor of 1-2 to 1-12, according to the engineer's judgment.

For again, if the sentence as to factors be taken literally, as suggested, it inculcates exactly the reverse of good practice. To conform with the uniform results of experience, as indicated in recent discussions, it should rather read as follows:

"For piles driven in firm soils about 1-6 of the extreme load by formula may be taken; but when driven in river mud or marsh, one-half, or even the full formula load, or even two or three times that load, may be taken with about the same assurance of safety as 1-6 in firm soils."

The error in the original sentence lies in the fact that it allows twice over for the weakening effect of mud and soft material on the supporting power. No one doubts that a pile driven in mud is absolutely of far less value than one driven in firm soil; but that effect is far more than included in the comparative bearing power by any and all formulas which are based on the mean penetration under the last blows; because all experience indicates that the final bearing power of piles driven in mud is abnormally great in relation to the rate of penetration when driving, and not abnormally small. The supposed and sufficient explanation of this fact is that soft mud gradually settles into every fiber of the pile, so as to get a very firm grip upon it: whereas no such effect takes place with firm soils.

This fact alone shows that the sentence in question was not a carefully studied provision of four different factors for four different conditions, but rather that the thought in the mind of the writer was essentially as we interpreted it.—Ed.)

THE CAUSE OF THE HAMBURG CHOLERA EPIDEMIC.

Sir: Some time since you had an item to the effect that it was the water supply at Hamburg that caused the cholera trouble. We have been watching for further information on the matter. Have you the facts in the case? and if so, can you give them to us through your paper? J. H. Harlow & Co.

Pittsburg, Pa., Feb. 25, 1893.

(The item referred to appeared in our issue of Dec. 15, 1892, and stated that the water supply of the city is taken from the river Elbe, above the city, without filtration, although settling basins are used. During the height of the epidemic there were 31.4 new cases and 13.10 deaths per thousand from the disease in Hamburg, against 4.5 new cases and 2.21 deaths in the adjoining city of Altona, which takes its water supply below the Hamburg and Altona sewer outlets, but which thoroughly filters it.

The following additional information regarding the experience of Hamburg and Altona is from an article on "The Purification of Drinking Water by Sand Filtration," by Prof. W. T. Sedgwick, printed in the "Journal of the New England Water-Works Association" for December, 1892:

During the cholera epidemic of 1892, Hamburg, with a population of 622,530, had 17,975 cases and 7,611 deaths from Asiatic cholera. Altona, with a population of 143,000, had during the same time 502 cases and 328 deaths. The intake of the Hamburg water-works is about two miles above the city, but, it is said, not so far that the flood tide may not carry to it the sewage of Hamburg-Altona. The Elbe, at Blankanese, contains all the impurities present at the Hamburg intake, plus the sewage of Hamburg and Altona. Yet Altona suffered but little from the cholera, while Hamburg suffered severely. The Imperial Board of Health of Germany, in a recent publication, attributes the comparative exemption of Altona to the fact that its water supply was effectually protected throughout the epidemic by sand filtration.

The Altona intake and sand filters are located at Blankanese, about eight miles below the two cities.

Wandsbeck, a city of about 20,000 inhabitants, across the river from Hamburg, is supplied with water from inland lakes, which is filtered. This city had only 64 cases and 43 deaths from cholera. Some of the Hamburg streets are supplied with water from the Altona works, and it is stated that these remained unaffected during the epidemic. It is thought that many of the Altona and Wandsbeck cases were imported from Altona.

The city of Hamburg is now constructing an extensive filtration plant, consisting of settling basins, filter beds and a clear water reservoir. It is hoped that a part of the plant will be in operation by the coming summer.—Ed.)

THICKNESS OF RETAINING WALLS.

Sir: In your remarks on retaining walls in your issue of Jan. 26 you state that generally the thickness should be 0.4 of the height. Does this mean the thickness at the base, or the average thickness of the wall?

Yours truly,
J. L. Allison.

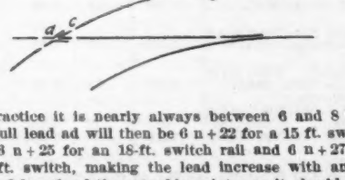
Coteau Landing, P. Q., Feb. 4, 1893.

(It means the thickness at every point with reference to the height above that point; but the thickness should generally be a little more than 0.4 times the height, especially toward the top.—Ed.)

SWITCH LEADS.

Sir: In answer to A. L. James' questions in his communication in your issue of Feb. 9, by "toe of frog" I mean the end of the rail of the frog in the switch lead, the point c in sketch, and by "heel of switch" I mean the fixed end of the planed switch rails, the point b in sketch.

If the curved position of the lead bc be calculated for a regular curve for frogs from Nos. 6 to 20, it will be found to be equal approximately to six times the number of the frog, if the portion of the frog dc is 7 ft.



(in practice it is nearly always between 6 and 8 ft.). The full lead ad will then be 6 n + 22 for a 15 ft. switch rail, 6 n + 25 for an 18-ft. switch rail and 6 n + 27 for a 20-ft. switch, making the lead increase with an increased length of the movable points, as it should, but 6 n is all the track man need remember. Yours truly,

Edwin Mitchell.

Chambersburg, Pa., Feb. 11, 1893.

THE DISCHARGE OF NIAGARA RIVER.

Sir: In your issue for March 2 you publish the report of Mr. J. C. Quintus on the Discharge of the Niagara River. Mr. Quintus has had wide experience in this class of work, and engineers interested in this problem have hoped that the results of his observations would clear up all doubt as to the amount of discharge of the river for various stages of the water level in Lake Erie. The formula, however, which he has deduced from his observations indicates that there must be some radical error in his work.

To fully understand the inconsistence shown by the discharge curve given in his report, it must be remembered that the head of Niagara River is funnel shaped, and gradually narrows up to a width of only about 1,500 ft., below which narrow section the river is much wider and deeper, so that a change of level of Lake Erie will always be greater than the corresponding change in the river surface below the rapids; and consequently the slope and discharge will increase rapidly with any increased elevation of the lake surface.

The formula deduced by Mr. Quintus gives the following heights on local gage, and discharges for stages of Lake Erie corresponding to even feet on the Buffalo Gage:

Buffalo Gage.	Local Gage.	Discharge cu. ft. per sec.
−4. ft.	−1.2 ft.	117,400
−3. "	−0.2 "	157,100
−2. "	+0.7 "	192,100
−1. "	+1.4 "	215,500
0. "	+2.1 "	230,100
+2. "	+3.2 "	242,300
+3. "	+3.5 "	243,400
+4. "	+3.9 "	241,500
+5. "	+4.1 "	240,400

From the above it will be seen that the increment of discharge, instead of increasing with the depth and slope, actually decreases to such an extent that an increase of 2 ft. in the lake level diminishes the discharge by 3,000 cu. ft. The natural fluctuation of the lake does not, of course, reach the extremes given above, but in times of severe storms the changes of lake level often exceed the figures given. Mr. Quintus only claims his formula approximate for such higher levels, but it is evident that it does not give results even approximately correct.

In 1877, 1878 and 1879 the discharge of the St. Clair, Niagara and St. Lawrence rivers was determined by Mr. D. F. Henry, M. Am. Soc. C. E., to be as follows:

St. Clair	225,000	cu. ft. per sec.
Niagara	265,000	" "
St. Lawrence	300,000	" "

The rainfall on the Lake Erie basin amounts to an average of about 100,000 cu. ft. per second, and on the Lake Ontario basin about 74,000 cu. ft. Hence, if the discharge of Niagara River is only 230,000 cu. ft., it is evident that the old determination of the St. Clair and St. Lawrence rivers are also much too great, otherwise the greater rainfall on the Lake Erie basin only produces an increased discharge of one-fourteenth of that on the Lake Ontario basin. As far as I know, the accuracy of Mr. Henry's work has never been questioned, and with a difference of 35,000 cu. ft. per second between his determinations and that of Mr. Quintus it is somewhat questionable whether either value may be used with safety. It is to be hoped that Mr. Quintus will be able to explain the trouble with his formula, and, if the error cannot b efound, that the engineer department will have additional observations made at a higher stage of the lake level, so as to settle beyond a doubt what the true discharge is for any ordinary stage of Lake Erie. Geo. Y. Wisner.

Detroit, March 6, 1893.

ERRATA IN "DISCHARGE OF NIAGARA RIVER."

Mr. J. C. Quintus, whose report on the "Discharge of the Niagara River" was published in our issue of March 2, sends us the following corrections; several of which had been detected by the proof-reader, but failed of correction in the type:

Page 194, last column, second line, 572.96 should read 572.86. Table No. II., mean depth for May 24, should read 23.3, instead of 22.3. Table No. III., the heading of sixth column should read "Observed at six-tenths depth, rev. per sec." The most inexcusable error is in the equation written under the cut of Smooth Curves of Discharge. This should be:

Local gage height = 2.037 + 0.624 x − 0.046 x², etc., as given correctly in the text.

DEFINITION OF SEWER AND DRAIN.

Sir: In your editorial comment upon a letter of Horace Andrews, City Engineer of Albany, with regard to the exact definition of the words "sewer" and "drain," you state that the views of municipal engineers on this subject would be welcome.

I will call attention to a distinction between these terms which has become quite common in Massachusetts owing to the increasing number of cases in which sewage and storm water are disposed of in separate systems of pipes, those of one system being called "sewers" and of the other "drains." A bill before the legislature a few years ago, relating to the sewerage and drainage of a city, contained these definitions: "In this act the terms 'drain' and 'drainage' refer to the method in a separate system of sewerage of disposing of the rainfall, surface and subsoil water, and the terms 'sewer' and 'sewage' to the method of disposing of domestic and manufacturing filth and refuse so far as water is the vehicle in conveying them away." An act of the legislature authorized a city to construct a system of drainage contained this statement: "In this act the term 'drainage' refers to rainfall, surface and subsoil water only, and the term 'drain' to the means of disposal thereof." In one of

the cities of the state there are now three classes of channels, one a partial system of "drains" for the removal of storm water; another a complete system of "sewers" to take sewage only; and the third a complete system of "underdrains," which are placed beneath each sewer to take the subsoil water. In this city there are in places two pipes laid from the houses into the street—one for draining the cellar into the "underdrain" and the other for conveying the sewage to the "sewer." In this case it seems proper that one of these pipes should be called the house drain and the other the house sewer.

In view of this greater complication of the sewerage systems of the present day as compared with the time when but one channel was provided for carrying liquids of all kinds, I would suggest that it is very undesirable to make the distinction between "drain" and "sewer" depend upon the relative sizes or the number of persons using them, but that they should be defined with reference to the character of the liquids which they convey. Upon this basis I would define the word "sewer" to mean a channel for the conveyance of sewage, and would define "sewage" to be water-carried domestic and manufacturing filth and refuse, whether this is kept by itself or diluted by storm and subsoil water; and I would define the word "drain" as a channel used to convey surface and subsoil water only, or either one of these. I would use in a similar way the terms "sewerage" and "drainage"; for example, I would call the extensive works which provide for the sewerage of the city of Boston the "Boston Main Sewerage Works," and not the "Boston Main Drainage Works," as they are now called.

Very truly yours, F. P. Stearns.
Chief Engineer State Board of Health.

Boston, Mass., Feb. 15.

(In looking over our own definition and the suggestions made by Mr. Stearns, it would seem better if we eliminated the word "drain" entirely from every channel carrying liquid refuse of any kind, even rainfall contaminated by the filth of the street surface and disposed of in a separate system of conveyors. The term "drain" is one of the oldest in our language, dating from a time anterior to the introduction of modern systems of sewerage, and has a broad and too undefined meaning. Leave it still to apply to the drainage of subsoil water, in towns or in the country; but apply the word "sewer" to every channel used for the conveyance of sewage, as that term is now accepted. As we regard it, the whole purpose of the present argument is to avoid confusion of meaning, now too often met with in the indiscriminate use of the words "drain" and "sewer" in the writing of specifications. It would probably be a hopeless task to attempt to change the meaning of the broad term of "drainage," as contrasted with "sewerage," as now accepted by the general public; but engineers can, and should, be more exact. By using the terms "main sewer" and "house," or "yard sewer," a distinction can be made in the class of sewer; and by confining "drains" to the removal of subsoil water only, the purpose of the two systems of channels seems plain enough. This is substantially the opinion of Mr. Stearns.—Ed.)

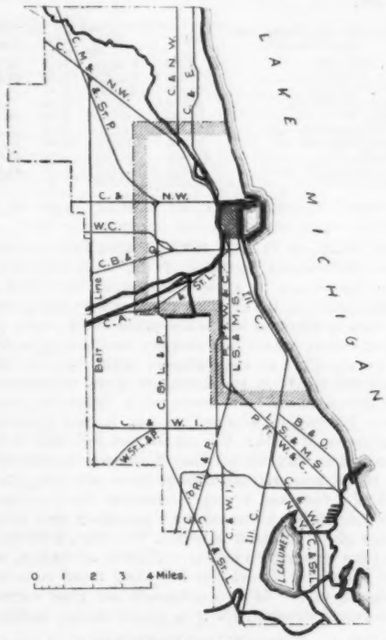
CHICAGO'S SOLUTION OF THE GRADE CROSSING PROBLEM.

The most radical "grade-crossing bill" ever enacted is the ordinance which passed the Chicago City Council Feb. 24 by a unanimous vote, requiring all steam railway companies within the city to elevate their tracks upon viaducts, the work to begin by July 1, 1893, and to be completed by Jan. 1, 1899. The ordinance divides the area of the city into three districts, the first comprising the area bounded by the Chicago River, Lake Michigan and Twelfth St. (the central business district); the second, an area about ten miles from north to south and extending three to four miles back from the lake, and the third covering the remainder of the city. On the accompanying map of Chicago we have sketched the outlines of these districts.

The ordinance provides that in the first district the work of constructing the elevated viaducts shall begin by July 1, 1893, and be completed by Jan. 1, 1895. In the second district work must begin by July 1, 1895, and be completed by Jan. 1, 1897. In the third district work must begin by July 1, 1897, and be completed by Jan. 1, 1899.

The railways covered by the ordinance are all freight or freight and passenger tracks operated by steam power. Railways carrying solely a passenger traffic by other motive power than steam are not included. The Illinois Central tracks, north of Fifty-seventh St., which are on the lake front and thus cross no street, are also exempted from the requirements of the ordinance.

The ordinance further specifies that the structures to be erected to carry the railways across streets shall consist of iron or steel girders supported on columns of a height sufficient to leave a clear headway of at least 16 ft. The columns must not be more than 24 ins. in "transverse diameter" at any point within 10 ft. of the street surface, and must have suitable fenders to protect their bases. No elevated structure can run longitudinally or diagonally along any street, but must cross it as nearly as possible at right angles. The rails must be of steel, the ties and guard rails may be of a "suitable quality of selected timber," the roadbed may be of asphalt or broken stone, supported by buckle-plates of iron or steel. Suitable devices must be provided for carrying off storm water and drip, and leading it to the city sewers. The railways have the sole right to the use of their structures for transportation and for telegraph, signal



Map of Chicago Showing Main Lines of Railway and Districts Prescribed in Ordinance Requiring Removal of Grade Crossings.

and telephone wires, but the city of Chicago is entitled to the free use of the structure for its police, fire alarm, electric light and telephone wires, so far as the railways' use of the same is not interfered with.

Prior to the construction of any elevated railway in accordance with the provisions of the ordinance, plans and specifications must be presented for approval to the Commissioner of Public Works, and must be followed in its prosecution. The railways are responsible for all damages caused to abutting property by the construction or operation of the elevated roads; and should any suit be brought against the city for having consented to the construction of the elevated roads, the railways are responsible for all damages and the costs of defense. The elevated roads may be operated with such motive power as the companies choose, but such power must be "fully equipped with all modern devices calculated to render it practically noiseless and smokeless, and to prevent the discharge of cinders and sparks."

The passage of this ordinance is the result of the investigation of a commission, whose report was published with editorial comment in our issue of July 1, 1892, which recommended the raising of the tracks on elevated structures as the best solution of the problem.

The accompanying map shows the main lines of railway entering Chicago, but it must be understood that these single lines represent anywhere from one to a dozen or more tracks, and that great network of sidings and subsidiary lines are not shown upon the map.

If the cost of placing every one of the present surface tracks upon an elevated structure were estimated, the sum involved would be a staggering one. As a matter of fact, however, the ordinance does not require this. It requires merely that the present surface tracks crossing streets or highways shall be removed by the time stated, and it remains for the railways to determine where they shall be permanently abandoned and where elevated structures shall take their place. Surface tracks which cross no streets, such as switches to manufacturing establishments, packing houses or storage yards are not interfered with. Cars can be transferred from the elevated to the surface tracks by hydraulic lifts or cable inclines.

The traffic capacity of elevated tracks, where cars can run at full speed, with no interference from street crossings, is so much greater than the capacity of the same tracks on the surface at present that fewer tracks will suffice to accommodate the traffic. The railways will doubtless unite in building two, four and six-track structures for joint use, protecting and facilitating train movement by complete block and interlocking systems. It is also to be remembered that the construction of steel or masonry viaducts is not essential. In the thickly built-up part of the city they will doubtless be used, as here the space underneath the railway tracks will command good rentals; but in the outlying parts of the city embankments between low retaining walls can be used with plate girders at street crossings, and the cost need not be excessive.

Of course, even with these qualifications, a heavy outlay must be made by the Chicago railways; to offset it they have the rentals of the space beneath their tracks, the revenue from the sale of large tracts of very valuable real estate in the heart of the city, which will be set free by the concentration of traffic on elevated structures, and finally, the saving of the present vast sum now paid annually for the maintenance of crossing planks, gates, and watchmen at the grade-crossings within the city limits, numbering over 1,500. The expense due to damage suits growing out of the present frequent grade-crossing fatalities is another item which should not be overlooked.

Doubtless the railway companies will resist in the courts the enforcement of the ordinance, and a long fight will precede its going into effect. It is interesting to notice, however, that at least one prominent railway officer, Mr. J. D. Springer, Vice-President of the Atchison, Topeka & Santa Fe, has studied the matter in a broader light, and in a letter to our contemporary, the "Railway Age," expresses the opinion that the elevation of the tracks is a necessity, and the best solution of the grade-crossing problem for both the railways and the city.

NOTES FROM THE ENGINEERING SCHOOLS.

The University of Illinois claims for apparent good reasons to have been the first college in America to add educational workshops to the plant for instruction in engineering, as will be seen in the following extract from an article by Dr. S. H. Peabody, Regent, published in the "Technograph" for 1890-91, in which is a rather serious charge against the president of some un-named and (to us) unknown Eastern college of having appropriated to itself credit which did not belong to it. Whatever the real facts as to either of these issues may be (and we do not desire to go into that question) the University of Illinois undoubtedly deserves honor for having moved so early in this direction.

The first movements toward the establishment of schools of civil engineering in America sprang from the demand for competent engineers of railways consequent upon the rapid development of that system of transportation in the third decade of this century. A second and larger impulse came about thirty years later, when Congress made its first subsidy for scientific training in the Land Grant Act of 1862.

The state of Illinois was among the first to move in the founding, under the provisions of this act, of a school of practical and experimental science, chartered in 1867 and opened to students in March, 1868. In those days the differentiation between the subjects of civil and mechanical engineering began to be more fully appreciated, and the institution here begun was one of the earliest to provide a distinct course of study, with separate equipment in each of these lines of

engineering work. The workshops here erected were the first distinctively educational shops opened in America, those at Worcester following soon after. But the Worcester shops were manufacturing shops, with educational tendencies, rather than shops purely and simply for instruction. The primary object of the shops at Champaign has been instruction, with very little consideration of manufacturing results. Dr. Runkle, of the Institute at Boston (Mass. Institute of Technology), has been called the father of shop-training in America, a distinction which he surely never claimed for himself. The shops at Champaign were built, equipped, and opened to students seven years before the first shop-work was done at the Massachusetts Institute of Technology. A full exhibit from our shops, including a line of work analogous to the so-called "Russian" system, a kind of work practiced here for at least four years previous, was placed in the Centennial Exposition in Philadelphia in 1876, and a diploma was awarded to this university therefor. Dr. Runkle's school-shop in 1877, was no more an innovation or a discovery than is Dr. Elliot's proposition of to-day that college students of larger capacity may graduate with a bachelor's degree after three years' study. The University of Illinois graduates a student when he has completed his course, and does not ask whether he has occupied three, four, or five years in so doing.

The shops at Champaign have sent out full lines of its courses of shop instruction, including blue-print copies of its drawings, and finished specimens of work, to various institutions scattered from the Atlantic to the Pacific coast. It was more complimentary than ingenuous for the distinguished president of an Eastern college to publish a complete series of fac-similes of our shop-drawings, reduced copies of blue-prints obtained from us, dimensions and all completely figured, with the statement that the series was perhaps the most complete extant, but without any credit to the institution where they originated, or any recognition of indebtedness thereto. The University of Illinois has never sought to protect for herself such products, but has freely distributed them to all inquirers, but she believes that she may modestly reclaim her own. She further confidently claims that in America there was no earlier practice in "Manual Training" than hers, and that nowhere else has that practice been more consistent or more successful. But this has been restricted to its proper sphere as an incident and adjunct to other earnest and scholarly culture, and never has been put forward unduly as a hobby, or a fad.

The following table, compiled for use in our articles on engineering schools, but omitted therefrom, shows in a striking way the increase in the general staff of instructors which has taken place at our oldest university in the brief period since our second engineering school was founded, 1847-8. The total staff of instructors in professional schools has increased over ten-fold, from 14 to 141. Even the medical school, Harvard's oldest and greatest professional school, has increased in nearly the same proportion, from 8 to 76.

Table showing the Comparative Number of Instructors in the Several Departments of Harvard University in 1848 and 1892, with Number of Students in 1892.

	No. instructors.		No. students. 1892.		
	1848	1892	Reg'r	Special.	Total.
Lawr nce Sci. sch	..	3	48	70	118
Divinity	2	11	22	17	39
Law	4	13	302	61	363
Medicine	8	76	388	11	399
Dental	..	22	51	..	51
Vet. med	..	8	27	4	31
Agric. and hort	..	8	14	..	14
Total prof. schools	14	141	852	163	1,015
Astronomy	3	8			
Mathematics	2	7			
Physics	..	6			
Botany, zool	2	11			
Geology, min'l'y	1	9			
Chemistry	1	13			
Modern lang	4	13	1,287	169	1,456
Ancient lang	5	17	(Graduates.)		
History	2	8	189		189
English, rhet, etc	1	15			
Polit. economy	..	4			
Philosophy	..	2			
Art and music	..	5			
Archæology	..	1			
Phys. geography	..	2			
Total H. College	21	121	1,287	169	1,645
Total of University	35	262	2,139	332	2,600

There are in addition 44 general officers and proctors not included above.

The undergraduate staff alone has increased from 21 to 121, or nearly six-fold, and the instructors in botany, zoology, geology, mineralogy and chemistry in the enormous ratio of 4 to 33. But it is surely a curious fact that, whereas it has been deemed necessary to add 29 new instructors in these theoretical or un-bread-and-butter sciences, it has been found necessary or practical to appoint only three to cover the whole field of applied science represented by the general term engineering, which is growing to be a broader instead of narrower term, and to stand for pretty much all the physical agencies for making life comfortable and endurable.

When we call the above "theoretical" sciences, we do not mean that chemistry, for example, has not a decided bread-and-butter side, and all the others similarly. But that side of these sciences is precisely that which is not taught in undergraduate colleges in general, and certainly not at Harvard. Neither should it be inferred that the three instructors tabulated as special to the Lawrence Scientific School are its only instructors. A number of the professors of the general faculty are really a part of its instructors, as may be inferred from the table.

It is also of no little significance that, even at Harvard, a conservative stronghold, the number of instructors in the ancient languages, who were 5 out of 21 in 1848, or nearly 25%, are only 17 out of 121, or 14%, in 1892. Taking into account the professional faculties of the university also, the instructors in ancient languages have fallen from 14.3% to 6.5%. The query cannot but arise, if such a decrease has taken place in 44 years, in a university which has steadily declined to make even an effort to keep abreast with even its old classical rivals in the attention given to modern applied science, how much of a figure is classical instruction destined to cut in the average university of 1936? We cannot but feel that it is destined to fall almost into innocuous desuetude; to be as Sanscrit and Hindustanee are now, the fad of a few, and a very interesting one for those who like it, but by no means a necessary part of a polite education, as it is to-day. We trust, however, that the tendency to merely utilitarian education, to the pursuit of knowledge for what there is in it rather than for its own sake, will not grow correspondingly stronger, for it is strong enough to-day.

RAILWAY EARNINGS IN 1892.

The results of railway operations in the United States in the calendar year of 1892, as indicated in increased net earnings, are, on the whole, disappointing. Owing to the unusually large crops of 1891, the year opened with a very favorable outlook for largely increased railway earnings. These expectations have been fairly well realized in the case of gross earnings, but, as before stated, decidedly disappointing in the case of net earnings. The factors which have contributed to this result have been of various degrees of influence, but the principal reason is to be found in the largely increased operating expenses due to the very liberal policy of railway managers in their expenditures for repairs and renewals in equipment and track in anticipation of the expected increase of traffic during the World's Columbian Exhibition. Moreover, coupled with the heavy grain and merchandise traffic, there have been the depression of business in the South and on the Pacific Coast, and the comparatively poor crops of 1892. The effect of the smaller crops is of course only to be found in the earnings of the closing months of the year, but in the South, especially, railway business has been very unsatisfactory throughout the whole year, owing to the low prices of both cotton and iron. In addition, it will be observed that the increase in traffic in the early months of the year was, for the most part, in the more bulky and cheaper classes of freight, which tended to increase operating expenses in a greater proportion than it did earnings.

In connection with the statistics of railway construction published in our issue of March 2, the following tables, compiled and rearranged from more detailed figures published in the "Commercial and Financial Chronicle," of Feb. 25, are, therefore, of considerable interest. These figures cover the operations of 210 railways, operating 131,625 miles of line, or 75.3% of the total railway mileage of the country. While these figures are not complete, and, moreover, include four large foreign lines, and do not include three or four large American systems, they are fairly representative of all sections of the country, and indicate very accurately the general conditions of the railway business. They also have the added virtue of being presented at an early date.

The tables so clearly explain themselves that little comment is necessary. Probably the most striking feature of Table I., showing the earnings by groups of railways, aside from the enormous aggregate of the total earnings, is the very large increase in both the gross and net earnings of the New England roads, as compared with those of the other groups. In net earnings this group shows an increase over twice as large as that of any other group, and in gross earnings its increase is but slightly exceeded by the Northwestern roads, if we except the Mexican group, which covers but two roads. On the other hand, trunk lines, which might be expected to show the benefits of the heavy grain movement, exhibit a decrease of 4.22% in net earnings. The increase of 3.35% in gross earnings for the group shows that this loss was due to increased expenditures. As might be expected, the favorable conditions which have prevailed in the anthracite coal trade are reflected in this group of railways, which shows a very satisfactory increase in both gross and net earnings. The Middle, Northwestern and Southwestern railways also show very satisfactory results, but the Pacific roads have barely escaped showing a decrease, and the Southern cross the line with a decrease of 2.02%, showing the effects of the general business depression in these two sections.

Some of the other more salient features of the year's business are more clearly brought out in Table 2, showing the gross and net earnings of a large number of roads for each month. It will be noticed that during the first half of the year the monthly increase in gross earnings are very satisfactory, and for February and March unusually so.

Table I.—Showing by Groups of Railways the Gross and Net Earnings and Earnings per Mile of Railway for 1891 and 1892.

Section or Group and No. of Roads.	Gross earnings 1891. 1 = 1,0 0	Gross earnings 1892. 1 = 1,000	Inc. p. c.	Mileage 1891.	Mileage 1892.	Net Earnings 1891. 1 = 1,000	Net Earnings 1892. 1 = 1 0 0	Inc. or Dec. p c	Gross earnings per mile of road. 1891.	Gross earnings per mile of road. 1892.
N. Eng. (16)	$ 9,286	$ 66,316	11.9	4,354	4,565	$18,136	$20,385	+ 15.2	$13,616	$14,540
Tr. Lines (21)	313,133	323,621	3.35	24,932	25,003	97,024	92,934	— 4.22	12,560	12,942
An. Coal (14)	104,588	112,040	7.15	4,075	4,075	34,572	33,094	+ 5.49	25,665	27,490
Mid. States (27)	43,624	46,047	5.55	3,558	3,576	15,965	17,025	+ 6.64	12,330	12,895
Mid. W'n. (37)	60,125	63,561	5.70	11,235	11,285	20,467	21,006	+ 2.63	5,375	5,635
Northwestern (18)	126,447	142,553	12 8	23,497	23,690	45,707	48,825	+ 6.82	5,270	6,045
Southwestern (17)	91,205	97,508	6.91	18,909	19,038	27,775	29,915	+ 7.32	4,370	5,130
Pacific (21)	147,395	147,177	....	25,549	25,913	55,040	55,162	+ 0.22	5,770	5,695
Southern (37)	69,910	71,845	2.76	11,136	11,425	22,793	22,333	— 2.02	6 285	6,300
Mexican (2)	11,581	12,719	9.84	3,021	3,065	3,854	4,652	+ 2.09	3,789	4,151
Total U. S. (210)	$1,027,291	$1,063,687	5.18	130,106	131,625	$338,133	$345,841	+ 2.23	$22,593	$2,635

Table 2.—Showing by Months the Gross and Net Earnings of Railways in the United States in 1891 and 1892.

	Gross earnings. 1891. 1=1,000	Gross earnings. 1892. 1=1,000	Inc. or dec., p. c.	Net earnings. 1891. 1=1,000	Net earnings. 1892. 1=1,000	Inc. or dec. p. c.
Jan. (126)	$52,488	$53,634	+ 2.18	$14,323	$13,442	— 6.15
Feb. (133)	50,806	58,187	+ 14 5	13,840	16,429	+ 20.4
March (131)	55,3:8	61,080	+ 10.3	16,470	18,728	+ 13.1
April (127)	53,381	56,466	+ 5 67	16,013	15.999	— 0.09
May (131)	58,377	60,506	+ 3.65	18,122	17.239	— 4.90
June (124)	54,215	58,540	+ 7.98	16,765	17,515	+ 4.47
July (123)	58.849	59.706	+ 1.46	19,362	18,579	— 4.05
Aug. (129)	65,224	69,009	+ 5.80	23,553	24,109	+ 2.36
Sept. (125)	66,592	68,539	+ 2.92	24,667	24,902	+ 0.95
Oct. (129)	73,481	73,309	— 0.11	28,250	27,642	+ 2.15
Nov. (131)	65,129	66,322	+ 1.83	23,695	23 137	— 2.3
Dec. (133)	61,501	62,643	+ 1.12	20,739	20,754	+ 0.26

The increases in gross earnings are not borne out by the net earnings of the six months, however. Quite heavy decreases in net are recorded in January and May, and a small decrease in April. The months of February and March show heavy gains in net as well as gross earnings. In fact, these two months are conspicuous for their favorable exhibits in comparison with the remaining months of the year. Like the first half of the year, the last six months show a general increase in gross earnings, and gains in three months and

losses in three months in net earnings. The figures in both cases, however, are much smaller than for the first six months. The effects of the smaller crops are shown especially during the last three months of the year. It should be stated, however, that in the last six months of 1891, with which comparison is made, the increases had been very large, both in gross and net earnings. This is one of the main reasons for the less favorable returns of this period of 1892.

In estimating the present year's new construction, these figures are of course significant only in a general way. Increased prosperity in railway earnings is usually followed by increased expenditures in repairs and improvements. This was the case in 1892, following the large crops of the previous year, and, owing to other conditions, is likely to be the case in a less degree in 1893, as stated in our review of the coming year's construction last week, when we gave as closely as possible at the present time the probabilities of railway work in 1893.

THE MONUMENT CREEK RESERVOIR, COLORADO..

The state of Colorado let a contract in the summer of 1892 for a dam designed to store 37,289,000 cu. ft. of water for irrigation. The dam is being built across Monument Creek, opposite the town of Monument, and is described and illustrated in the last report of the state engineer of Colorado, from which the following account is taken.

The dam is being built of sand and gravel, selected material and puddle, as shown by the accompanying section, substantially in accordance with the practice of the late Wm. J. McAlpine, as described in our issue of Nov. 17, 1888. The structure will be 855 ft. long on top, and with the other dimensions and characteristics shown by the section. The reservoir will have a water area of 61.94 acres.

The drainage area tributary to the reservoir is about 22 square miles. The normal flow of the stream in the spring and early summer is from 5 to 10, and in the fall from 2 to 3 cu. ft. per sec. The reservoir site is at an altitude of 7,000 ft., and the catchment area is subject to flood-storms. It is estimated that the reservoir can be filled from three to four times during the season.

The contract for constructing the reservoir was awarded to David McShane for $25,000, in June, 1892.

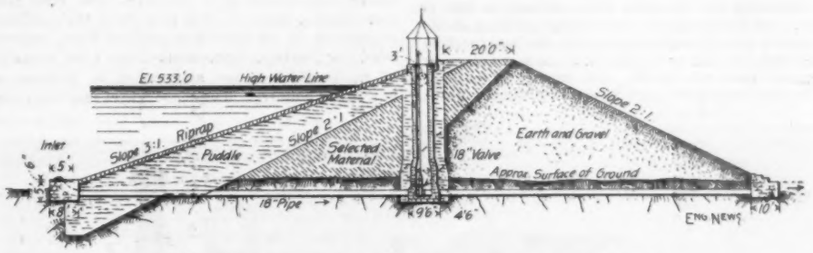
In digging the trench for the puddle two steam pumps were required to keep it free from the underflow. A part of the water is used to sprinkle the body of the dam, hose being attached to the pumps.

Two 16-in. discharge pipes will be laid beneath the dam, as shown by the accompanying section. The pipes will be laid in a trench excavated in rock, and will have concrete collars at each joint.

The principal items of labor and material included in the estimates for the dam were as follows:

Embankment,	cu. yds.	96,800
Excavation,	" "	14,000
Concrete,	" "	100
Masonry,	" "	50
Rip-rap,	sq. yds.	6,342

Mr. J. P. Maxwell is engineer and Mr. John S. Titcomb, deputy engineer of the state of Colorado, and the above work is being done under their direction.



SECTION THROUGH MONUMENT CREEK DAM, COLORADO.

COST OF VITRIFIED PIPE SEWERS AT GARDNER, MASS.

It is pleasing to note that engineers of late seem to be taking more pains than formerly to keep itemized records of the cost of the work carried out by them.

Cost of Sewers at Gardner, Mass.

Size.	Pipe and laying. Average cut.	Length, Ft.	Cost of labor.	Manholes. No.	Price.	Total cost, excluding iron-work	Cost of building sewers, including brick, cement and sand. Total	Per ft.	Frt.	Cost of manhole curbs and covers.	Flush gates. No.	Cost	Cost of pipe.	Cost of carriage.	Cost of sewers, including all materials. Total.	Per ft.	Rock. Total yds.	Price per yd.	Total cost.	Cost of gravel.	Cost of sewers, including rock and gravel. Total	Per ft.	Cost extra work	Cost of sewers complete. Total	Per ft.
								cts.																	
Work done in 1890.																									
12	7.4	6,131	2,452	30	27	810	3,262	53	16	343	..	.....	1,659	96	5,377	.88	770	4.50	3,464	....	8,840	1.44	198	9,038	1 47
10	10.8	444	200	2	27	54	254	57	1	23	..	.....	133	5	416	.94	163	4.50	734	....	1,149	2.59	....	1,149	2.59
8	6.8	1,044	418	4	27	108	526	50	3	46	..	.....	151	13	738	.71	139	4.50	625	....	1,363	1.31	102	1,465	1.40
8	5.8	328	98	2	27	54	152	47	1	23	..	.....	49	4	229	.70	6	4.50	27	....	256	.78	8	264	.81
6	4.6	226	45	2	27	54	99	44	1	23	3	13.50	35	2	174	.77	53	4.50	238	....	411	1.82	....	411	1.82
	....	8,173	3,213	40		1,080	4,293	..	21	458	3	13.50	2,027	120	6,934	....	1,131		5,088	....	12,029	....	308	12,327	....
Work done in 1891.																									
10	6.8	3,904	1,874	15	30	459	2,324	60	8	172	..	.....	1,257	7	3,767	.96	453	5.50	2,490	8	6,265	1.60	124	6,389	1.63
8	6.8	5,490	2,471	24	30	720	3,191	58	12	274	..	.....	1,206	10	4,693	.86	782	5.50	4,299	5	8,996	1.64	14	9,010	1.64
8	7.5	1,3 5	698	8	30	240	938	67	4	91	1	4.50	400	6	1,443	1.04	3	5.50	15	....	1,459	1.04	1	1,459	1.05
6	6.5	5,329	2,263	22	30	660	2,923	54	11	252	9	40.50	765	10	4,002	.74	173	5 50	953	....	4,955	.92	5	4,960	92
6	6.5	511	220	2	30	60	280	57	2	23	..	.....	78	1	394	.77	37	5.50	202	....	595	1.17	....	595	1.17
	....	16,689	7,536	71		2,130	9,666	..	38	812	10	45.00	3,706	34	14,299	....	1,448	....	7,959	13	22,270	....	144	22,413	....
Work done in 1892.																									
8	4.6	180	63	1	30	30	93	52	1	12	..	.....	24	2	130	.72	5	4.50	23	4	157	.87	....	157	.87
6	6.0	1,560	525	4	30	120	645	43	2	46	5	22.50	152	15	883	.59	116	4.50	523	....	1,406	.94	1	1,407	.94
6	6.5	2,389	946	9	30	270	1,226	52	5	104	3	13 50	242	23	1,613	.68	1	4.50	5	....	1,617	.68	13	1,630	.68
6	10.6	906	548	3	45	135	682	69	2	35	2	9.00	100	8	836	.81	9	4.50	40	....	876	.88	.	876	.85
	....	5,066	2,092	17		555	2,646	..	9	197	10	45.00	518	46	3,462	....	131	....	591	4	4,056	....	14	4,070	....
Total work done in 1890-91-92.																									
12	7.4	6,131	2,452	30	....	810	3,262	53	16	343	..	.....	1,659	96	5,377	.88	770	....	3,464	....	8,840	1.44	198	9,038	1.47
10	7.1	4,348	2,074	17	....	504	2,578	59	9	191	..	.....	1,390	12	4,183	.96	616	....	3,224	8	7,414	1.70	24	7,538	1.73
8	6.8	8,437	3,747	30	....	1,152	4,899	58	20	444	1	4.50	1,830	35	7,233	.87	934	....	4,989	9	12,231	1.45	24	12,256	1.46
6	6.8	11,012	4,567	42	....	1,299	5,866	53	23	482	22	90.00	1,373	58	7,900	.72	389	....	1,961	....	9,861	.90	19	9,879	.90
	6.9	29,928	12,840	128		3,765	16,605	55	68	1,463	23	103.50	6,252	201	24,695	.83	2,709	....	13,638	17	38,346	1.28	465	38,811	1.30

The accompanying table, which needs no comment, showing in detail the cost of sewers laid at Gardner, Mass., in the summers of 1890, 1891 and 1892, was sent to us by the engineers for the system, Messrs. McClintock & Woodfall, Boston, Mass.

THE USE OF BURLAP FOR LEVEE PROTECTION DURING HIGH WATER.

The successful substitution of burlap for straw and brush for the protection and strengthening of levees during high water was described before the Illinois Society of Civil Engineers on Jan. 27 by Mr. E. J. Chamberlain, Engineer for the Sny Island Levee Drainage District Commissioners. Mr. Chamberlain states that he is unable to learn of the previous use of burlap in the manner described below for levee protection. He states that from the comparison of the use of burlap during the past year with other modes of protection during the previous seven years of his connection with the Sny levee he cannot speak too highly of the efficiency of burlap, where high water strengthening must be done.

The Sny levee is located along the east bank of the Mississippi River. The drainage district to which it belongs comprises 110,000 acres of land in Adams, Pike and Calhoun counties, Ill. The office of the district is at Pittsfield, Ill. Mr. A. V. Wills is President, Mr. S. E. Hewes, Secretary, and Mr. H. B. Atkinson, Treasurer of the commission. Mr. M. Hardy is the fourth member of the commission.

Mr. Chamberlain's paper, with some condensation and slight alteration, is as follows:

Many levees, for want of sufficient means, are not constructed to withstand the highest expected floods; others, supposed to have been of sufficient strength, often develop weak places quickly, requiring prompt action if a crevass would be averted. Such levees may be made to withstand much more water if judiciously cared for during imminent danger than if left alone.

Our levee is composed of all grades of material usually found in an alluvial district, from the impervious black clay or "gumbo" to coarse river sand and the most unreliable quicksand.

The best material by far for emergency use, when the water is high, is burlap. The kind used last year was 6 to 8-oz. material. The principal tools used were shovels, with occasionally some axes and wheelbarrows.

To prevent abrasion from wave action two or more widths of burlap, fastened in place by small stakes 2 to 4 ft. apart through the edges of the burlap, with sandbags 3 to 6 ft. apart upon the middle, are much more efficient than brush and straw, that will require double or quadruple the time to obtain and put in place.

For the more dangerous character of weaknesses, such as the sloughing away of the land side slopes, and the moving away of the quicksand substratum of levee foundations, where the same has been uncovered by borrow pits upon the land side, the burlap should be laid (lapping the edges) upon the portion needing the strengthening and weighted with sandbags to hold in place. The burlap and the lower tier of sandbags should be parallel with the embankment, with the bags touching each other, so that no stream of water and quicksand may start from underneath. The balance of the bags used ought to be from 1 to 3 ft. apart, giving the water an opportunity to escape through the burlap. We used some of the closely woven burlap, also some muslins, but found it objectionable because of its holding the water, thereby saturating the embankment higher, requiring a carpeting of burlap from the base to near the top of the levee in some instances.

We had places that discharged several gallons of water and quicksand per second before found; others that were so soft that they, in the language of the Sny Islander, "would mire a horse blanket." For such places efforts should not be made to stop the water, for that will but soften the embankment and cause the water to break out elsewhere. Such places should be covered over and far enough each side with burlap to secure a solid foundation. Then the burlap should be weighted with sandbags, and a wall of sandbags 2 or 3 ft. high placed around the "spring of water" to give a counter-pressure to lessen the scouring force, which, with the burlap to prevent the quicksand from escaping, will control any leak or sloughing.

The river was against our levee continuously for upward of 120 days during the summer of 1892, and the highest stage was after about 90 days, making a severe strain upon the embankment. Many of the weakest places were so situated that no amount of teams and men, nor boats, could have got brush and straw on the ground in time for service, because of the mud. A dozen or less men on horseback could carry all the burlap and sandbags along the top of the levee that were needed for any one place.

I wish to emphasize the importance of being always ready, by saying: Never let the sun go down without the officer of the night guard going over his division in company with the respective day patrolmen, so that he may be fully informed as to what has been done during the day, and better know where to expect danger through the night; and at all suspected places have burlap and sandbags filled and tied before the day working force is released. By so doing two or three of the night patrol can accomplish more than one hundred men if they must be summoned from their respective homes; for, in legal parlance, "Time is the essence of this contract."

For two or three miles of "gumbo" levee, requiring additional height, use was made of 12-in. stock boards, held on edge by stakes driven on each side and earth well tamped behind the board.

COMPOUND EXPRESS LOCOMOTIVE; JURA-SIMPLON RY., SWITZERLAND.

The type of engine known as the American, or eight-wheel type, having four coupled wheels and a leading four-wheel truck, is coming into increasing use for express and general passenger service on European railways. Engines of this type ride well on light track, and run easily on lines with sharp curves, but they are equally advantageous on the best tracks, as shown by experience in this country, and by the slow but steady introduction of this type in England. It has been claimed by English engineers that while this type of engine, with its flexible wheel base and great steadiness, due to equalizing the springs, may be well adapted for light and uneven tracks, it is not required for the heavy tracks of English railways. The rigid English engines, however, will only show their claimed superiority on an absolutely perfect track, without sags, low joints or depressions of any kind, a quality of track which is not approached in England or any other country. The eight-wheel engine is now

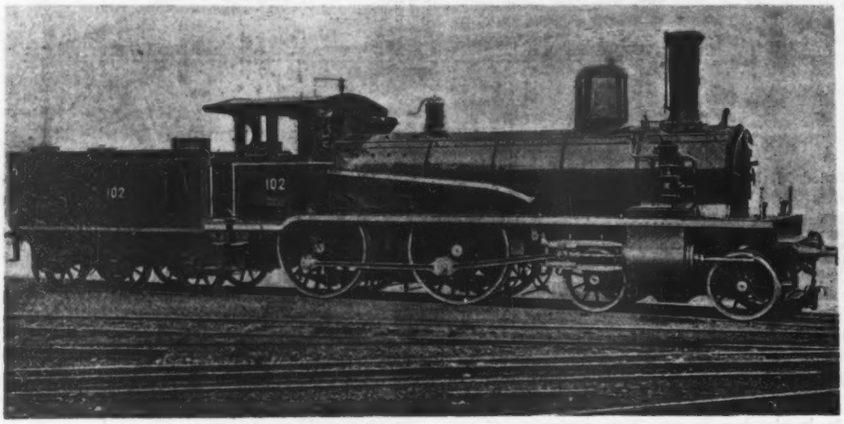


FIG. 1. EIGHT-WHEEL COMPOUND LOCOMOTIVE; JURA-SIMPLON RAILWAY.

a familiar type in English locomotive equipment, though in some cases the springs are not equalized, so that the full benefit of the type is wilfully dispensed with.

During the last few years this type of engine has been introduced in many other European countries, and we illustrate this week a two-cylinder compound eight-wheel engine, built for express train service over the Jura-Simplon Ry., Switzerland, for the accompanying cut and description of which we are indebted to the "Schweizerische Bauzeitung."

In designing this engine, the following improvements upon the older types in use were sought to be obtained: 1. Increase of maximum speed from 43.5 miles to 56 miles per hour by the use of larger driving wheels. 2. Increase of heating surface from 1,107 to 1,390 sq. ft., with a corresponding enlargement of grate area. 3. Increase of length of wheel base and flexibility of wheel base by the adoption of a four-wheel truck in place of a single pair of leading wheels. 4. Economy in performance by the use of the compound system. Upon delivery the locomotives were to be subjected to the test of hauling a train load of 180 tons on a 1% grade at a speed of 28 miles per hour. The two first locomotives of this type were delivered

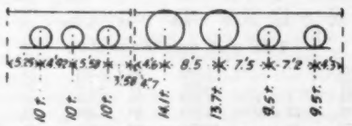


Fig. 2. Diagram of Wheel Base and Wheel Loads.

in March, 1892, and are at present hauling the express trains between Geneva and Lausanne. The official running tests have proved these engines to be highly efficient. Their registered maximum speed was 54 miles per hour, and the saving in fuel consumption ranged between 10 and 12%. The locomotive is built as a two-cylinder compound engine, on the Mallet system, and is fitted with the Von Borries automatic starting gear. The cylinders are outside, with valve chests on top, and the Stephenson link valve gear inside the frames. The ratio of piston areas is 1 to 2.2. The piston rods are carried through the cylinder heads. The boiler is of Krupp mild steel, and the fire-box and smoke-box tube plates are of copper. The fire-box has a brick arch.

The tender is carried on three axles, and has a horseshoe tank of 3,400 gallons' capacity. The locomotive is fitted with the Westinghouse driver brake and train brake, and the Haushaelter speed indicator. The safety valves are of the Ramsbottom duplex pattern, and the dome is placed at the smoke-box end of the boiler, an arrangement very common in continental railway practice. The smoke-box has an extension front, in which the receiver is placed, and a damper is placed over the top of the smokestack. A sand-jet apparatus is placed in front of the main drivers. The cab is of iron and, as on many continental roads, is a much more complete affair than the so-called cabs of ordinary English engines, but it is set low down, has merely windows in the front, and is probably not fitted with seats. The old-fashioned idea that a man will attend to his work better under uncomfortable conditions than when housed and seated in a roomy cab, still prevails throughout Europe, and particularly in England, and an English engineman accustomed to stand up with his face against a little circular window in a weather board, and to wrap himself up in oilskins and greatcoats in wet or cold weather, must have some feeling of envy for the more comfortable and humane condition of the American engineman sitting in a high cab with a good view of the line from the windows and having a door opening onto the running board.

Except for its wheel housing and low cab, this Swiss engine has a decidedly American appearance. Fig. 1 is a general view of the engine. Fig. 2 gives the wheel base and wheel loads, and Fig. 3 is a cross-section through smoke-box and cylinders. The general dimensions of the engine are as follows:

Cylinder, h. p.	17.7 × 25.6 ins.
" l. p.	28.4 × 25.6 "
Driving wheels, diam.	6 ft. 0 ins.
Truck wheels, "	3 " 4.6 "
Tender wheels, "	3 " 4.2 "
Wheel base, driving	8 " 6.4 "
" " total, engine	23 " 4 "
" " tender	10 " 6 "
Heating surface	1,390.5 sq. ft.
Grate area	21.6 "
Working pressure	180 lbs.
Water in boiler, with water level 5⅝ ins. over crown sheet	1,096 gallons
Weight in working order, on drivers	61,270 lbs.
" " " on truck	42,870 "
" " total of engine	104,140 "
" " tender	66,120 "
" " engine and tender	170,260 "
Tender, water capacity	3,440 gallons
" coal capacity	11,000 lbs.

TWO ENGLISH ELECTRIC RAILWAYS.

(From our London correspondent.)

The City & South London Ry. (electric underground) has been in operation for over two years, and is now emerging into commercial prosperity, as

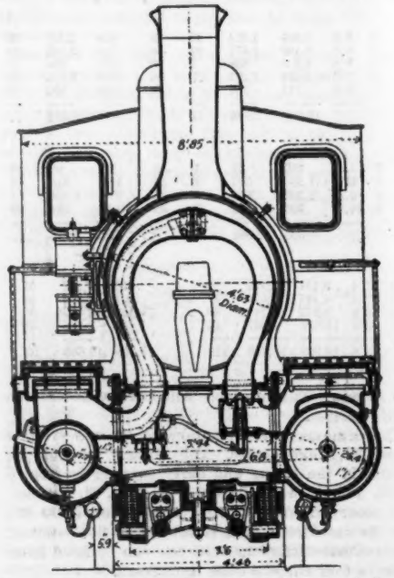


Fig. 3. Cross Section Through Cylinders of Compound Locomotive; Jura-Simplon Ry.

the ordinary shareholders have received a dividend of 5⅝% per annum for the last half-year's working. This is the first time that this class of shareholder has been paid any return on his capital in the undertaking, and although the return is only tri-

fling, yet it promises to be better in the future. Up to the present time the line has carried over 12,000,000 passengers, the figures for the four half years ending Dec. 31, 1892, being as follows:

First half year..	2,412,343	Third half year..	2,813,162
Second " " ..	2,740,055	Fourth " " ..	3,217,602

It will be observed how the number has been gradually increasing, and for the present year the same state of affairs obtains. This will be understood when it is mentioned that the receipts during the first four weeks of this year averaged no less than $450 more per week than in the corresponding period of 1892. The additional service of trains recently put on has caused the receipts per train mile to slightly diminish, but the expenses per train mile have been reduced, as shown by the table. New sidings are about to be erected at the Stockwell terminus, and this will enable the railway to deal better with the traffic from the city of London during the busy parts of the day. Until this is accomplished, it is not intended to proceed with the extension of the railway to Clapham.

	—Four half years to end of 1892.—			
	1st.	2d.	3d.	4th.
Loco. expenses per train mile.....	18 cts.	16 cts.	15¼ cts.	14 cts.
Total expenses per train mile.....	43 cts.	39½ cts.	38¼ cts.	34¼ cts.
Passengers per train of 3 cars..	45	46	47	48
Working expenses to total receipts..	79%	76%	70%	67.9%

The Liverpool Overhead Ry. (elevated electric), which has been described in previous issues of Engineering News (Dec. 28, 1889; Sept. 5, 1891; Jan. 30 and Oct. 27, 1892), was opened Feb. 4. The line runs along the quays from end to end of the Liverpool dock system for nearly seven miles, and has been in course of construction for about three years. Generally speaking, the line consists of iron girders supported upon channel iron columns and having Hobson's iron trough flooring upon which the permanent way is laid direct, no ballast being used. Flange rails are laid on longitudinal timbers. The normal spans are of 50 ft., but there are some twice that length, while a tilting bridge is provided near Sandown Dock, and a swing bridge crosses the entrance to the Stanley Dock. There are 13 stations, with platforms 120 ft. long and 12 ft. wide. Stairways give access to the stations from the street. The generating station contains six Lancashire type boilers, working at 120 lbs. pressure; four horizontal, compound condensing engines of 400 I. HP. each, and four Elwell-Parker dynamos, each giving 450 amperes at an E. M. F. of 500 volts. From the switchboard the current passes to feeders and from these to a steel conductor laid between the rails and placed on porcelain insulators, supported on cross timbers. The electrical energy is taken up by means of hinged cast iron collectors attached to the car trucks, and is conveyed to the motors, then returns to the generators by the ordinary rails. A train is composed of two cars, and each has a motor on one of the trucks. They are arranged so that they can be controlled from either end of the train by the driver. Each car accommodates 56 passengers, both first and second-class, and there is communication throughout the length of the train. The trains are fitted with the Westinghouse brake, and when full of passengers a train weighs 40 tons. A five minutes' train service has been introduced, but it is possible to run a train every three minutes. The consulting engineers to the company were Sir Douglas Fox and Mr. Greathead, and the contractors for the electrical plant were Elwell-Parker, Limited, now the Electric Construction Co.

THE BACK-PILING OF WATER.

In our issue of Jan. 12, 1893, there appeared an open letter on the above subject written by Mr. E. T. Abbott, C. E., of Minneapolis, and addressed to Mr. N. M. Edwards, C. E., of Appleton, Wis. Mr. Abbott denied the theory, advanced in testimony in a lawsuit by Mr. Edwards, that a dam or other obstruction in a stream backs up the water for an indefinite distance up the stream. We have received from Mr. Edwards a reply to the letter of Mr. Abbott which, so far as it bears directly upon the subject, corresponds with generally accepted ideas, already given in these columns. As the contention between Mr. Abbott and Mr. Edwards is largely of a personal character we do not republish it. We departed somewhat from our usual practice in publishing Mr. Abbott's letter, which was also somewhat personal, but we will not transgress further by publishing a second letter of the same kind. The discussion of the question of the back-piling of water must be considered closed, therefore, unless there is some exact technical information to be added to it.

ELEMENTS OF WEATHER IN THE UNITED STATES OF MOST INTEREST TO ENGINEERS FOR THE MONTH OF JANUARY, 1893.

[Furnished to Engineering News by the Department of Agriculture.]

	Station.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—rain and melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average	Max.	Min.	Range.	Average	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt	5.7	45	-26	71	7.5	42	SW	1.78	1.02	8
	Portland, Me	15.2	48	-5	53	7.8	26	NW	2.19	0.82	12
	New York, N. Y	23.3	52	1	51	11.8	48	SE	3.56	1.12	12
	Pittsburg, Pa	21.6	57	-3	60	8.3	31	W	2.36	0.52	16
	Chicago, Ill	12.0	46	-16	62	16.8	49	SW	2.08	0.60	13
	Omaha, Neb	15.9	47	-9	56	8.5	35	NW	0.28	0.14	7
	St. Paul, Minn	3.2	33	-23	56	7.7	36	NW	0.73	0.22	13
	Duluth, Minn	4.8	37	-22	59	6 6	34	E	1.06	0.28	13
	Bismarck, N. Dak	5.5	42	-32	74	9.5	52	N	0.73	0.21	12
	Average	11.9	45.2	-15.0	60.2	9.4	39.6	.....	1.64	0.55	12
Southern Cities.	Washington, D. C	24.6	57	-6	63	7.5	36	NW	1.85	0.90	10
	Louisville, Ky	24.9	64	-10	74	9.1	36	NW	2.57	1.58	14
	St. Louis, Mo	24.8	60	-2	62	13.0	40	NW	0.33	0.10	7
	Savannah, Ga	44.3	71	18	53	9.2	54	NW	2.21	1.77	8
	Leavenworth, Kan	21.8	50	-2	52	9.9	42	NW	0.10	0.01	4
	Jacksonville, Fla	49.2	72	24	48	7.9	34	SW	0.98	0.32	9
	Chattanooga, Tenn	53.8	69	5	64	5.7	32	NW	2.39	0.68	10
	New Orleans, La	50.2	72	29	43	9.5	32	NW	2.50	1.53	7
	Memphis, Tenn	38.8	68	13	55	8.4	34	NW	1.42	0.79	3
	Palestine, Tex	48.2	76	22	54	6.4	29	NW	1.14	0.75	9
	Average	36.1	65.9	9.1	56.8	8.7	34.9	.....	1.55	1.85	8
Western Cities.	Helena, Mont	21.9	59	-42	101	7.3	48	W	1.72	0.62	8
	Port Angeles, Wash	36.0	54	-1	55	5.5	34	E	4.82	1.13	14
	San Francisco, Cal	47.4	60	36	24	10.0	40	S	3.05	1.39	6
	Salt Lake City, Utah	27.6	48	4	44	5.0	36	SW	0.82	0.48	3
	Denver, Colo	38.3	64	13	51	10.0	48	NW	0.05	0.04	2
	Yuma, Ariz	59.2	79	33	46	6.6	36	NW	T	T	0
	Santa Fé, N. Mex	33.6	52	13	39	7.3	28	SW	0.26	0.12	4
	Average	37.7	59.4	8.0	51.4	7.4	38.6	.....	1.53	0.54	5

The tearing down of a chimney 114.8 ft. high, near Aachen, Germany, was effected in a peculiar manner, described in the "Thonindustrie-Zeitung." As it was desired to utilize the brick taken from the structure, for other building purposes, care was taken to recover them in an unbroken condition. For this purpose a cast iron box was set up at the bottom of the interior of the chimney. The closing of its hinged door was made air-tight by a rubber strip. From the top of this box a plank chute extended to the top of the chimney; its joints were also made air-tight with putty. Into this air-tight chute of 4 to 6 ins. interior width, the bricks were thrown, falling upon an elastic air cushion, landing unbroken in the box below. As the work progressed, the opening of the chute was lowered by simply sawing off a part.

The Texas Pine Timber Co., a Boston syndicate, sold to the Reliance Lumber Co., of Beaumont, Tex., on Feb. 13, $750,000 worth of standing timber. This is said to be the largest single timber sale in the South.

The examination of German railway bridges has revealed the existence of 63 cast iron bridges, of which, however, the main parts have been replaced by wrought iron. Of these 63 bridges 33 are to be replaced by wrought iron structures, while the 30 remaining bridges are being carefully watched. The total number of railway bridges is given by the "Deutsche Bauzeitung" as 10,722.

The line of maximum snow-fall on the North American continent, said the late Lieutenant Schwatka, probably lies throughout its greatest extent in our own country, and fairly below the northern boundary at that. As the result of his wide Arctic experience, he says the trouble from snow to railroad travel lessens as we go north from the northern tier of our states.

Valuable papers on topics of the greatest interest to naval and marine engineers have been received by Commodore G. A. Melville, Engineer in Chief, U. S. N., as contributions from prominent foreign naval and marine engineers to the Marine and Naval Engineering Section of the World's Engineering Congress, to open in the first week of August, 1893, at Chicago. The discussions will be carried on in English, French, German and Spanish.

Defective springs have been giving trouble on the South Indian Ry. The Deputy Consulting Engineer for Railways, in his last annual inspection report of the South Indian Ry., stated his belief that the frequent derailment of trains on that line was due, among other things, to the unequal strength of the springs. Sir George Bruce, the company's consulting engineer, to whom the matter was referred, concurred in this opinion. Particular attention is, in future, to be paid to the proper construction of the springs.

Steel railway axles may now be used in India. Two years ago, acting upon the advice of the Consulting Engineer to the India Office, the government of India prohibited the use of steel in the manufacture of railway axles and recommended Lowmoor iron instead. As the result of further and more recent inquiries into the suitability of the better qualities of iron and steel for the manufacture of axles and their relative cost, the government has now withdrawn the prohibition in the case of steel of suitable quality.

African railway projects continue to increase and the British government has directed that an official survey shall be made on the Gold Coast of the railway routes proposed by Sir Brandforth Griffith within the British Protectorate. The work will at once be proceeded with, and Capt. Irvine Lang, of the Royal Engineers, has been selected for the command of the surveying expedition, which will be accompanied by an armed escort.

Clocks with dials for 24 hours have been recommended by the Engineer in Chief of the East Coast Railway, of India, as the 24-hour system of rotation is being rapidly adopted.

The keel has been laid for the "Centurion," at West Bay City, Mich., which is to be the first of three of the largest steel steamers on the lakes. The "Centurion" will be 378½ ft. long, 45 ft. beam, 26 ft. deep, and is to be propelled at 14 miles per hour by triple-expansion engines. The estimated cost is $270,000.

The Electric Transit Co. has been incorporated in Passaic Co., N. J., with a capital of $100,000, to experiment with an invention of Mr. Alfred Speer for a rapid transit system from which he claims a speed of "2 to 3 miles per minute." It is an elevated single-track road, from which is suspended cars pointed at each end, with side wheels to prevent oscillation. The side guide-rails also serve as conductors for electricity which is to operate the 8-ft. wheels carrying the car. Single, light cars would be used on 10-mile blocks; and if the plan is a success the company proposes to operate them in connection with a surface trolley system.

Attempts have been made during late years, but so far without success, to use Italian lignite as a substitute for coal. It has been calculated that the quantity of xyloid-lignite in the more important mines throughout Italy amount to 75,000,000 tons, yielding at present an annual output of 331,000 tons, which could be raised to 768,000 tons. Besides this the deposits of tar-lignite, which may contain 8,570,000 tons, and which at present yield 33,100 tons a year, could be raised to 185,000 tons. The two qualities of lignite, taken together, would then give a total production of less than 1,000,000

tons, while every year Italy consumes imported coal to the extent of 4,500,000 tons. Taking into account the heating power of Italian lignite, which is said to be half that of English coal, this maximum production would represent less than one-eighth of the actual importation of coal. Tests have been made on one of the Italian railways of a patent lignite fuel treated with some chemical which is said to make it suitable for such use.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

PITTSBURG, AKRON & WESTERN.—Surveys are now in progress for the Akron & Eastern R. R., from Akron, O., to New Castle, Pa., 70 miles. A portion of this line may be completed this year.

HUDSON RIVER R. R. & TERMINAL CO.—We are informed that this company has 3 miles of railway under construction in New Jersey which was omitted from the figures of probable railway construction in 1893, given in our issue of March 2.

OHIO SOUTHERN.—McArthur Bros., Gotwald Building, Chicago, Ill., will let the contract for grading 22 miles of the Springfield-Lima extension.

Projects and Surveys.

CLEVELAND TRANSFER.—Chartered in Ohio to build a 4-mile transfer railway at Cleveland. Among the incorporators are: H. A. Blood, J. W. Wardwell, H. R. Moore and Chas. H. Blood.

NEW HAMPSHIRE.—A bill is before the New Hampshire Legislature authorizing a railway to be built from Milford, N. H., to a connection with the Brookline & Pepperill R. R.

EASTERN CENTRAL.—Ch. Engr. R. H. Lee, of Loudonville, O., writes us that 140 miles of this line from Yellow Creek to Galion, O., have been surveyed, and that the work will ultimately be continued from Galion to LaFayette, Ind., 220 miles.

LAKE SUPERIOR & ISHPEMING.—A press dispatch says: "The surveys for the Lake Superior & Ishpeming Ry. are all completed, and if the Marquette people keep their promises in the way of land donations, the road is an assured fact. It will commence at Ishpeming and run through Negaunee and Marquette to a point a little south of Presque Isle. It will connect the Lake Angeline, Lake Superior, Cleveland-Cliffs, Jackson and Negaunee mines with the lake. At present the contemplated road will be 18 miles in length but if built it will eventually be extended to Champion. If that is done Marquette will be given a through route to Chicago over the Chicago, Milwaukee & St. Paul R. R. At the Lake Superior outlet will be built ore docks and a steel plant and blast furnaces. The miners may ship their ore in vessels to Lake Erie ports, or they may make it into steel right on the spot. James M. Barnett, John C. Holt, J. H. K. Burgwin and A. G. Hodenpyl, of Grand Rapids, Mich., are backing the scheme. Some New York capitalists are also interested in it. It will cost $1,500,000. It will be a standard-gage road, with 80-lb. rails, heavy oak ties on the curves and 30-ton ore cars. The grade is a heavy one, and the road will have to be exceptionally well-built and ballasted. The prospects for the road, if built, are bright. It will run through a well-populated country, and one that is productive enough to furnish all the freight we will need to carry. If all goes well, work will be commenced April 1."

BRAZIL, BAINBRIDGE & NORTHERN INDIANA.—Chartered in Indiana to built a railway from Brazil to Logansport, Ind., 120 miles. Among the incorporators are: Wm. J. Craig, Layman A. Walton, Vernon S. Barnes, Louis B. Smyser and others.

LANDISVILLE & CAPE MAY.—A press dispatch says: "The survey for the new Cape May railway, which is to extend from Landisville to Cape May, a distance of 41 miles, will be completed in about three weeks, when the work of construction will be begun. The projectors have practically accepted an offer to build the line, and the work will be completed, it is said, in 60 days, in time for the summer business. At this rate the contractor will have to build about 1¼ miles of the road a day, but he has assured the new company that it can be accomplished. Caspar W. Haines, at one time in the employ of the Pennsylvania Railroad is to be Engineer in Chief. It is said the new road, which will connect with the Philadelphia & Reading line at Landisville, will be eight miles shorter than the present route of the West Jersey, between Camden and Cape May."

Southern.—Existing Roads.

DARIEN SHORT LINE.—It is stated that this company will extend its line 20 miles to a connection with the Florida Central & Peninsular R. R.

TUSCALOOSA NORTHERN.—It is stated that this road, which was graded some time ago from the Warrior River toward the Warrior coal fields, 7 miles, has been purchased by J. W. Woolfolk, of Tuscaloosa, Ala., who proposes to complete it.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC.—This company is surveying a line from Burnside to Burksville, Ky., about 40 miles.

ABERDEEN & WEST END.—A five-mile branch is to be built to open up timber lands.

GLENDON & GULF.—Work will be resumed on the line from Gulf to Fair Haven, N. C., as soon as the weather permits, and the grading and trestle-work pushed to completion. Tracklaying will begin as soon as possible. Ch. Engr., Frank D. Jones, Fair Haven, N. C.

JACKSONVILLE, ST. AUGUSTINE & INDIAN River.—The contract for building 14 miles of the 24-mile extension from Rock Ledge to Melbourne, Fla., has been let to John D. Macleman, Montreal, P. Q., Ch. Engr., Chas. O. Haines, Cocoa, Fla.

EAST & WEST R. R., OF GEORGIA.—Work is reported in progress upon this railway from White Plains to Davisboro, Ga., 60 miles. Pres., R. M. Mitchell, Sparta, Ga.

Projects and Surveys.

TAKOMA, BURNT MILLS & SANDY SPRINGS.—The bill authorizing the construction of the portion of this railway in the District of Columbia has passed the house and is now before the Senate. The bill provides for a starting point at Brooks Station instead of Takoma City as before noted.

NORTH CAROLINA.—Bills have been introduced into the North Carolina Legislature chartering the Elizabeth & Pasquotank R. R. Co., and the Harriman, Franklin & South Atlantic R. R. Co.

Northwest.—Existing Roads.

BURLINGTON, CEDAR RAPIDS & NORTHERN.—It is announced that work may be continued on the Forest City extension beyond Armstrong, Ia., this spring. The town of Forest City has voted a 3% tax in aid of the enterprise.

Projects and Surveys.

HIGHLAND & MINERAL PLANT.—This company, whose incorporation was noted last week, will build a railway 28 miles long. Among the incorporators are J. M. Sands and Rich. Kennedy, of Mineral Point, Wis.

Southwest.—Existing Roads.

GREENFIELD & NORTHERN.—This company is making surveys for an extension from Aurora, Mo., to Marble Cave, about 25 miles south.

CHICAGO, ROCK ISLAND & PACIFIC.—This company has secured an amendment to its charter authorizing the construction of a branch from a point on its main line in Wise Co., Tex., to Dallas, Tex. Surveys are now in progress for the continuation of the main line from Bowie to Ft. Worth, Tex.

ST. LOUIS, IRON MT. & SOUTHERN.—This company proposes to extend its Coal Hill branch 30 miles into the coal fields of Arkansas. It is reported that work will begin at once.

EAST LINE & RED RIVER.—A press dispatch says: "A charter has been filed here by H. W. Poor and Francis Hyde, of New York, and J. J. Frey, W. M. Giles, Thomas Randolph, W. B. Munson, T. H. King, W. A. Williams, E. M. Alvord and W. T. Atkins, of Texas, with a capital of $3,000,000, to operate this road, and extend it to Shreveport, La., and Whitesboro, Tex."

Projects and Surveys.

KANSAS CITY, BOONVILLE & ST. LOUIS.—This company has been chartered in Missouri to build a railway from Independence to Boonville, Mo., 90 miles. A. A. Mosher, of Kansas City, Mo., is interested.

SPRINGFIELD, SEDALIA, MARSHALL & NORTHERN.—It is announced that the contract for this railway from Springfield, Mo., north to Miami, Mo., has been let to Quigley & Co., of St. Louis, Mo., the work to be completed by April 1, 1895.

Rocky Mountain and Pacific.—Existing Roads.

NEW ORLEANS & NORTHWESTERN.—A press dispatch says: "Mr. A. W. Smith, an English capitalist, and J. Nicholl, representing English capital, with headquarters at Chattanooga, Tenn., are here, looking over the New Orleans & Northwestern Ry., with the view of extending financial aid to the enterprise. If aid is extended, the road will be constructed immediately to connect with the Houston, Central Arkansas & Northern at Collins, La., giving through connection to the North and West."

PECOS VALLEY.—It is announced that the money necessary to build the extension of this road has been secured. Sixty miles from Eddy to Hagerman, N. Mex., are to be built at once.

NEVADA SOUTHERN.—Grading on the first division of 30 miles from Goffs to Manvel Junction, has been completed, and all the rails are on the ground. The company has ordered passenger cars, and will use the freight cars of the Atchison, Topeka & Santa Fe for the present. No motive power has yet been ordered; one train a day will be run. Surveyors are locating a route through New York mining district toward Ivanpagh, and this line will be built this year.

Projects and Surveys.

SEATTLE & NORTHEASTERN.—Chartered in Washington to build a railway from Seattle, Wash., to a connection with the Great Northern line, about 60 miles. Thos. Burke, of Seattle, Wash., is interested.

ELECTRIC RAILWAYS.

BENNINGTON, VT.—A project is on foot to build an electric railway from Hoosack Falls, N. Y., to Bennington, Vt. The Hoosack Falls Water Power & Light Co., Hoosack Falls, N. Y., are chiefly interested.

DEDHAM, MASS.—The Norfolk Suburban Electric St. Ry. Co. has secured authority to build a line from Dedham Center to the Hyde Park line.

SHREWSBURY, MASS.—The selectmen have granted a franchise to the State Central St. Ry. Co. for an electric railway in this town.

PHILADELPHIA, PA.—Chartered, Philadelphia & Allentown St. Ry. Co.; Philadelphia to Allentown; capital stock, $1,000,000; Pres., W. R. Grace, New York, N. Y.

PHOENIXVILLE, PA.—Chartered, Phoenixville Electric St. Ry. Co.; Phoenixville to Mont Clare; capital stock, $50,000; Directors, L. Knowles Perot, Chas. P. Reed, Wm. C. Hamies, Philadelphia, Pa.

SILINE GROVE, PA.—A charter has been secured for an electric railway between this place and Clement Station, 6 miles long.

SUNBURY, PA.—Chartered, Pen Argyle, Bangor & Water Gap Electric R. R. Co.; Wind Gap to East Stroudsburg; Pres., A. J. Strob, Sunbury, Pa.

WILKES-BARRE, PA.—Chartered, Pittston Suburban St. Ry. Co.; Pittston to Moosic; capital stock, $90,000; Pres., John T. Lenahan.

BEDFORD CITY, VA.—A franchise has been granted to M. H. Clayton, of Roanoke, Va., and others, for an electric railway.

MANCHESTER, VA.—Wm. H. Palmer, T. M. R. Talcott, Geo. H. Jewett and others have petitioned the supervisors of Chesterfield Co., for authority to build an electric railway from Manchester to Petersburg, 21 miles.

WELLSBURG, W. VA.—The Wellsburg & Lazearville R. R. Co, has been chartered to build an electric railway.

ATLANTA, GA.—A charter has been obtained for an electric railway from Atlanta, Ga., to Lithia Springs, 16 miles. Thos. Camp, Atlanta, Ga.

THOMASVILLE, FLA.—An electric railway is to be built. W. H. Mitchell is interested.

CHICAGO, ILL.—W. S. Reed & Co., Chicago, have been awarded a contract for constructing the Chicago & Southwest Railway. It will be 7 miles long and run from Slate and 95th Sts. to Oaklawn. Work will be commenced as soon as the weather will permit.

CHIPPEWA FALLS, WIS.—It is stated that the electric street railway is to be extended to Eau Claire.

DALLAS, TEX.—The Queen City Ry. Co. has been chartered to build the electric railway projected by J. S. Armstrong and others.

SAN ANTONIO, TEX.—The Alamo Electric St. Ry. Co. has been granted a franchise for about twelve miles of electric railway. Chas. A. Harris, New York, N. Y., is Pres.

CENTRALIA, ILL.—Chartered, Marion Co. Rapid Transit Co.; capital stock, $75,000; S. N. Pierce, O. V. Parkerson, John F. Sugg.

HORSE AND MOTOR RAILWAYS.

JERSEY CITY, N. J.—Chartered, Jersey City, Harrison & Kearney R. R. Co.; capital stock, $100,000; P. Hauck, Harrison, N. J.; J. Crawford, Jersey City.

MEADVILLE, PA.—Chartered, Meadville St. Ry. Co.; capital stock, $30,000; Pres., Geo. D. Trawin.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Central Elevated Ry. Co. has elected the following officers: Pres., Geo. E. Adams, Vice-Pres., David Kelly; Ex. Com., W. E. Hale, Chm., Owen F. Aldis, Geo. E. Adams, E. R. Bliss, C. Norman Fay, E. M. Fowler, B. M. Eckhart. This is the company which proposes to build the loop line in the downtown district.

CHICAGO, ILL.—The Chicago North Side Elevated Ry. Co. has been chartered to construct a railway in Chicago from a point between the Chicago River and 12th St. and between the south branch of the river and Lake Michigan, running in a northerly direction to the northern limits of the city, with a branch leaving the main line at a point between North Ave. and Fullerton Ave. and running westerly to a point at or near the north branch of the river, thence northerly to a point at or near the north city limits; also with a branch leaving the last mentioned branch at a point between Addison St. and Fullerton Ave., and running west and north to point at or near the north city limits. The incorporators, who are also to constitute the first board of directors, are: Henry A. Cravener, of Chicago, Alexander Clark, of South Evanston, Robert H. Smith and Henry H. Banford, and Paul Schwartzlose, Opera House Block, Chicago.

HIGHWAYS.

RHODE ISLAND.—John E. Bowen has prepared plans for the extension of Valley St. from the public square in Olneyville to Arlington, a distance of 5,580 ft. The shortest route at present is 8,100 ft.

NEW YORK.—The supervisors of Queens and Suffolk counties have engaged J. P. Jervis to make surveys for a proposed joint county road.

PENNSYLVANIA.—The citizens of Abington have voted to issue bonds for $80,000 to macadamize the roads of the township.

DISTRICT OF COLUMBIA.—A bill was passed last week directing the district commissioners to prepare a plan for the extension of a permanent system of highways over all that portion of the district not included within the limits of the cities of Washington and Georgetown. This system is to be as nearly as possible in conformity with the street plan of Washington, and the highways are to be from 90 to 160 ft. in width.

TENNESSEE.—A new turnpike road is to be built from the Thorn Grove road to Riverdale, in Knox county, the work to commence as soon as the weather will permit.

TEXAS.—The commissioners of McLennan county are considering the opening of a road from Waco to the Falls county line, a distance of about 20 miles.

BRIDGES, TUNNELS AND CANALS.

HARTFORD, CONN.—A stone arch bridge over Park River, opposite Union Place, to cost $19,000, is talked of.

STRATFORD, CONN.—The county commissioners of New Haven and Fairfield counties, Conn., have received notice from the United States War Department that they must build a larger and higher drawbridge over the Housatonic River at Stratford, Conn., by Dec. 1, 1893. Such a bridge will cost $75,000.

NEW YORK, N. Y.—The King Iron Bridge Co., Cleveland, O., has been awarded the contract by the New York Central & Hudson River for the Harlem River drawbridge. It will be designed to carry four tracks, resting on a solid floor, and it is said that it will probably be one of the heaviest drawbridges in the world.

NEY YORK, N. Y.—Bids will be received by the department of public works, N. Y., until March 28, for the construction of a bridge over the Harlem Ship Canal, at Kingsbridge, New York city. The work will consist of a swing span, 270 ft. long, giving a clearance of 26 ft. over M. H. W.; one 100-ft. deck lattice span at each end, and earth embankments, leading up to the bridge from each end. The foundations for the two abutments, the two swing rest twin-piers, and the pivot pier are to be sunk partly by the pneumatic process, partly built either inside of a coferdam or directly on the exposed dry rock bottom of the government cut. The cut is at present closed at each end by a dam, and the water will be admitted into it only after completion of the bridge. The bridge has an asphalt roadway 36 ft. wide, and two asphalt sidewalks, 7 ft. wide each. The estimate of quantities contains 2,100 cu. yds. of pneumatic work, 7,340 cu. yds. of masonry, 1,636,000 lbs. of metal, and 110,000 cu. yds. of earth filling. The work has to be completed within 240 working days, and the appropriation is $400,000. Prof. Wm. H. Burr is the Consulting Engineer; W. G. Triest, Asst. Engr.

DES MOINES, IA.—The following bids were received for the iron bridge noted in our issue of Feb. 16, by the board of public works, March 3, 1893: A. M. Raum, $66,000; St. Louis Bridge Co., $65,980; Fair Williams & Co., $64,775; Missouri Valley Bridge Co., $63,500; Kansas City Bridge Co., $62,578; R. D. Wharton & Co., $61,000; Canton Bridge Co., $59,600; Wisconsin Bridge Co., $59,380; Youngstown Bridge Co., $58,700; Variety Iron Works, $57,700; Wrought Iron Bridge Co., $56,900; St. Joseph Iron Bridge Co., $55,300; Toledo Iron Bridge Co., $54,873; Massilon Iron Bridge Co., $49,900; Geo. E. King Bridge Co., $48,970; King Bridge & Mfg. Co., $48,000. The bids will be considered by the board, and the contracts will not be let for two weeks.

WATER-WORKS.

New England.

NEWPORT, ME.—Surveys will be made to determine the practicability of a gravity water supply from Pittsbury Pond. A company may be organized.

RAYMOND, N. H.—The people have voted to build works, with a stand-pipe.

BELMONT, MASS.—An appropriation of $1,500 has been made for surveys and plans for works, and E. P. Frost has been elected water commissioner.

LOWELL, MASS.—A contract for two 3,000,000-gallon Deane pumps in connection with the driven well plant has been awarded to the Deane Steam Pump Co., Holyoke.

MEDFORD, MASS.—Driven wells have been recommended for a temporary supply in one part of the city, but it is also recommnded that an engineer be employed to prepare plans for a permanent supply in connection with the present works.

DANBURY, CONN.—Engr. B. H. Hull, Bridgeport, has been engaged to make plans for a dam and storage reservoir on Begg's Stream. The dam will be of earth from 25 to 28 ft. high, length not determined, and will probably flood 300 acres; it will have a masonry cove. A small dam is proposed below the main dam with a filter bed between. S. H. Rundle, E. S. Benedict and Jas. E. Walsh propose to incorporate the Mountainville Spring Water Co., with a capital of $15,000.

MADISON, CONN.—Surveys for works have been made by a company.

MIDDLETOWN, CONN.—The people have voted 236 to 207 not to build new reservoirs, at an estimated cos of $215,000.

Middle.

AMITYVILLE, N. Y.—The Amityville Water Co. has elected J. S. Davis Pres. and S. Ketchem, Jr., Secy. and Treas. It is said that construction will be started at once.

AUBURN, N. Y.—The stockholders of the Auburn Water-Works Co. have voted to sell the works to the city for $425,000, the transfer to be made July 1.

HILLBURN, N. Y.—It is reported that the Mountain Spring Water Co. has bought the water-works of the Ramapo Iron Works, which supply Hillburn, and will extend the system to and through Suffern; W. W. Snow, R. Riggs, J. B. Suffern and others are directors.

MARLBOROUGH, N. Y.—The Marlborough Water-Works Co. has been incorporated; $26,000; O. B. Whitney, Jas. S. Carpenter and others. The town board has voted to allow the company to build works.

LAKE MOHONK, N. Y.—It is reported that A. K. Smiley will put in water and electric light plants, water to be pumped from the lake to a reservoir.

OYSTER BAY, N. Y.—The incorporation of the Oyster Bay Water Co. is proposed by Chas. DeKay Townsend, Geo. W. Fletcher and others.

IRVINGTON, N. J.—Thos. H. Jones, Dr. Jas. English, Jr., and others, have petitioned the village trustees for permission to incorporate the Irvington Water Co.

KENSINGTON, PA.—Jas. H. Harlow & Co., Pittsburg, are preparing plans for works.

LEBANON, PA.—The city council has authorized the commissioners of the water and lighting departments to employ a hydraulic engineer to make surveys and investigations of Hammer Creek, about ten miles from this city, from which it is proposed to secure an additional supply. The investigations are to include a chemical analysis of the water and estimates of its maximum and minimum flow, as well as the cost of connecting the proposed new plant with the old supply and erecting a pumping station. The estimated cost will be about $10,000.

SALTSBURG, PA.—R. H. Wilson has been employed by the borough to make plans and estimates for works.

TOPTON, PA.—The people have voted 94 to 26 for water. Chf. Burgess, D. B. Heist.

VERONA & OAKMONT, PA.—Plans for works are being prepared by Jas. H. Harlow & Co., Pittsburg.

CAMBRIDGE, MD.—A franchise has been granted to a local company; Pres., Jas. Wallace; Secy., W. Land Henry. There will be a pump, stand-pipe, six miles of mains and 30 hydrants, the latter rented for $1,300 per year.

Southern.

MARTINSVILLE, VA.—It is reported that $25,000 of 6% water bonds have just been sold, and that works will be built.

BARNESVILLE, GA.—The people have voted 248 to 7 for bonds for works. It is reported that the contract has been let.

GALLATIN, TENN.—Address the mayor regarding proposed works

North Central.

CINCINNATI, O.—The following bids for cast iron pipe for the ensuing year have been received: Bradford Pipe Co., Cincinnati, $26.25; specials, $70. Dennis Long & Co., Louisville, $26; specials, $70. Shickle, Harrison & Howard Co., St. Louis, $25.50; specials, $60. Lake Shore Foundry, Cleveland, $25.80; specials, $70; Addyston Pipe and Steel Co., Cincinnati, $24.75; specials, $50.

EAST LIVERPOOL, O.—The construction of a reservoir is proposed.

ELMWOOD, O.—The people will soon vote on issuing $20,000 of bonds for works.

HARTWELL, O.—The new supply will be from instead of furnished to the Wyoming works, as stated last week.

HARTWELL, O.—Bids will be received until March 23 for 583 tons 4, 6 and 8-in. cast iron pipe, 13,000 lbs. specials, 52 stop valves and valve boxes, 60 double hydrants and laying and setting the same. W. W. Myers, Com. on W. Sup.; T. H. Marpe, Vil. Clk.

LOCKLAND, O.—Water and sewerage systems are talked of.

OBERLIN, O.—Supt. W. B. Gerrish informs us that on April 3 the people will vote on issuing $5,000 for an elevated tank and for mains.

STUBENVILLE, O.—Land for a reservoir has been bought; estimated cost of reservoir, $50,000.

WINNETKA, ILL.—The contracts for the new works have been awarded as follows: Putting in plant, James Wigginton, Evanston, $29,885; pipe-laying, about 12 miles, 4 to 12-in., The Heidenrich Co., $59,600; valves, Eddy Valve Co., Waterford, N. Y.; 147 hydrants, Crane Co., Chicago.

YELLOW CREEK, ILL.—Bids for putting in works are wanted.

KENOSHA, WIS.—It is reported that bids are wanted for works after plans by Engr. Geo. H. Benzenberg, Milwaukee. The intake pipe, it is said, will extend at least 5,000 ft. into the lake to 30 ft. of water, and two compound duplex pumps are proposed.

Northwestern.

ARMSTRONG, IA.—Works are talked of.

DOON, IA.—It is reported that works will be built.

OXFORD JUNCTION, IA.—Works are projected.

BUFFALO, WYO.—It is reported that the council has decided to build works at a cost not to exceed $40,000, and that an effort will be made to secure Elwood Mead, Cheyenne, as engineer.

Southwestern.

MARYVILLE, MO.—The stand-pipe here failed on Feb. 28. It was 18½ x 135 ft. and, it is said, had 100 ft. of water in it at the time of its failure.

ST. LOUIS, MO.—Bids for constructing two settling basins at the Chain of Rocks will be received until March 21. The following are the approximate quantities of the work to be done: 85,000 cu. yds. earth excavation, 1,000 cu. yds. borrowed earth, 37,000 cu. yds. puddle, 15,500 yds. concrete, 900 cu. yds. brick masonry, 20,000 sq. ft. granitoid, 15,800 cu. yds. stone masonry, 18,000 sq. ft. stone coping 12 ins. thick, 400 sq. ft. paving 12 ins. thick, 150 lin. ft. 60-in. iron pipe, 200 lin. ft. 24-in. iron pipe, 1,100 lin. ft. 24-in. clay pipe. Geo. Burnet, Pres.; E. S. Foster, Secy., Bd. Pub. Impts.

ABILENE, TEX.—Plans for a new reservoir are being made.

AUSTIN, TEX.—The contract for 6,770 tons of 24 to 6-in. cast iron pipe has been awarded to the Howard-Harrison Iron Co., Bessemer, Ala., for $25 per ton, and for 190 tons of specials to the same firm for $50 per ton. The total price is $178,750. Detailed bids will be given in a later issue.

JACKSONVILLE, TEX.—Works are again proposed. Fred. Hann can give information.

Pacific.

SANTA ROSA, CAL.—Steps to secure municipal works are being taken.

SEWERS.

DEERING, ME.—Bids have been received for the following pipe sewers: 24-in., 2,152 ft.; 20-in., 1,342 ft.; 12-in., 3,285 ft.; 10-in., 731 ft.; 8-in., 7,706 ft. The total bids were as follows: Mansur & Blake, Haverhill, Mass., $28,427; W. A. Cole, Waltham, Mass., $15,421; G. S. Staples, Portland, $41,793; J. H. Flannagan, Portland, $21,828; J. Cashman, Newburyport, Mass., $27,180; F. L. Allen, Worcester, Mass., $28,886; E. McGillicuddy, Portland, $34,750; Thos. Shannahan, Portland, $44,741; R. W. Shannahan, Portland, $38,698. Bids have not yet been received for the pipe and for certain filling, which are estimated to cost nearly $12,000.

THE WEIRS, N. H.—It is proposed to construct a sewerage system at The Weirs, to cost about $10,000. The selectmen of Laconia can furnish particulars.

BENNINGTON, VT.—At a village meeting March 6 the citizens voted to construct the proposed sewerage system. The plans were prepared by McClintock & Woodfall, Boston, Mass.; length of system, 7.36 miles; estimated cost, $34,000.

NORTH ANDOVER, MASS.—The report of the committee on sewerage, recommending the adoption of a system to cost about $44,000, has been accepted.

HARTFORD, CONN.—Rudolph Hering, New York, was in the city last week in consultation with the city engineer with regard to the sewerage problem.

BROOKLYN, N. Y.—Bids will be received by C. Furgueson, Jr., Garfield Building, until March 15, for a main sewer in Twentieth ave., between 75th and 86th sts., in the town of New Utrecht.

BUFFALO, N. Y.—The lowest bids for two sewers were those of Thos. McKeown, $41,861, and for one sewer, August Gisel, $38,300.

SYRACUSE, N. Y.—Henry C. Allen, Cy. Engr., reports that last year about eight miles of sewers were constructed at a cost of $109,500, and that contracts for the coming season have been awarded to the amount of $38,300.

ATLANTIC HIGHLANDS, N. J.—The contract for a sewerage system has been awarded to Conover & Newton, at $30,677. More detailed prices will be published next week.

NEWARK, N. J.—Plans have been prepared for sewers estimated to cost about $175,000. The city surveyor recommends that a part to cost about $108,000 be constructed as soon as possible.

ROSELLE, N. J.—The Roselle Sewerage Co. has been incorporated by H. P. Baldwin, W. H. Peddle and others, to construct a sewer through Roselle and Linden to Staten Island Sound; capital stock, $35,000.

BRISTOL, PA.—The citizens have agreed to increase the tax rate in order to provide a system of sewerage for the town.

HOMESTEAD, PA.—The citizens have voted to issue bonds for a system of sewers, to cost over $15,000.

OCALA, FLA.—A contract has been awarded to the Monolithic Sewer Co. for 550 ft. of 3.5-ft. sewer, the company to accept in payment $15,000 of 20-yr. 8% bonds.

PORTSMOUTH, O.—The city has been authorized to issue bonds for $35,000 for the proposed sewer in Ward 6. There will be 7,830 ft. of brick and 6,830 ft. of pipe sewer, and it is hoped to have it completed this coming summer.

MINNEAPOLIS, MINN.—All bids for 1,000,000 sewer brick have been rejected on account of irregularity. The lowest were $9.57 and $10.49 per M.

ST. PAUL, MINN.—We are informed by Geo. L. Wilson, Asst. Cy. Engr., that bids will be received until March 13 for 4,293 lin. ft. of 9 to 15-in. pipe sewer, 24 manholes, 11 catch basins; cut, 8 to 13 ft. A contract has been awarded to the J. D. Morgan Mfg. Co., at $20,000.

REDWOOD FALLS, MINN.—The city engineer has prepared plans for a sewerage system estimated to cost $80,000.

DES MOINES, IA.—We are informed by R. B. Dennis, Cy. Clk., that bids will soon be asked for about one mile of 36 to 72 in. brick sewer; average cut, 11 ft.; estimated cost, $31,680; and about 10 miles of 12 to 24-in. pipe sewers; average cut, 12 ft.; estimated cost, $105,600.

LE MARS, IA.—The city council is considering plans for about 12 miles of sewers, estimated to cost $73,000. It is intended to commence the construction this spring.

GLENWOOD, MO.—It is reported that a sewer system is to be constructed at a cost of about $90,000.

KANSAS CITY, KAN.—The estimated cost of a sewer system, including pumping station, in ward 6, is $45,000. The city engineer has recommended the adoption of the Shone ejector system, and that the outlet to the river be made below the Kansas Ave. bridge.

TOPEKA, KAN.—Plans are being prepared for important sewer extensions.

OKLAHOMA CITY, OKLA.—The city has voted $17,500 for a sewerage system.

SALT LAKE CITY, UTAH.—J. J. R. Croes, New York, has been engaged as consulting engineer to examine the plans of the proposed gravity sewer, to which reference was made last week.

LOS ANGELES, CAL.—F. C. Young has been awarded contracts for two sections of the outfall sewer, at $58,013. The clerk has been instructed to advertise for bids for three additional sections.

MODESTO, CAL.—The contract for a sewerage system has been awarded to Wm. Bessler & Co., San Francisco. There were 22 bidders. Improvement bonds for $85,000 have been voted.

STREETS.

BOSTON, MASS.—The superintendent of streets will receive bids until March 13 for North River flagging and for beach gravel.

SOMERVILLE, MASS.—The board of aldermen has appropriated $24,000 to pave Washington St.

WORCESTER, MASS.—The annual appropriation bill includes $100,000 for highways, $45,000 for streets and $16,000 for parks.

BUFFALO, N. Y.—The department of public works will receive bids until March 18 for paving stone, curbing, crosswalks, etc., for 1893.

SYRACUSE, N. Y.—Paving contracts amounting to $445,725 have been awarded, the most of the work to be done during the coming season. H. C. Allen, Cy. Engr.

ERIE, PA.—The city engineer will receive bids until March 15 for paving State St. with asphalt.

OVERBROOK, PA.—Chas. F. Stauffer, Wayne, has been awarded the contract for street work at this place. It is said that $6,000,000 will be spent in the improvements contemplated.

RICHMOND, VA.—The streets committee has recommended work to cost $551,562.

ATLANTA, GA.—Bids will be received at the office of the city clerk until March 30 for paving Peachtree street with sheet asphalt.

OWENSBORO, KY.—A special election will be held March 13 to vote on the issue of $65,000 of 5% bonds for street improvements.

CLEVELAND, O.—The director of public works will receive bids until March 29 for paving 6 streets with Medina block stone, 4 with Medina common stone, and 4 with paving brick.

GRAND RAPIDS, MICH.—H. A. Collar, Cy. Engr., informs us that a bill has just passed the legislature authorizing the city to issue bonds for $400,000 for improvement purposes, and it is expected that orders for improvements will soon be passed.

MONROE, MICH.—The city clerk will receive bids until March 13 for $25,000 of 4% paving bonds. We are informed by W. Baldwin, Cy. Surv., that bids are being asked for 10,000 sq. yds. of brick paving and 9,700 lin. ft. of Medina stone curbing; estimated cost, $35,000.

ST. PAUL, MINN.—Plans and estimates have been prepared for paving five streets. The city engineer estimates the cost of repaving as follows: With cedar blocks on plank foundation, $1.15 per sq. yd.; cedar blocks on concrete, $1.65; granite blocks, $2.10; asphalt, $2.75.

KANSAS CITY, MO.—The public improvements committee has recommended ordinances for two miles of paving with brick, sandstone, granite or asphalt.

PASADENA, CAL.—Asphalt paving to cost about $45,000 has been ordered. The estimated cost of the paving is 25 cts. per sq. ft., and of granite block guttering, 30 cts. per sq. ft.

ELECTRICAL.

BROOKLYN, N. Y.—The Edison Electric Light Co. will increase its capital stock from $1,500,000 to $2,500,000 in order to increase the capacity of its plant. The company has three stations. The capacity of the Pearl St. station is 100,000 lights, and this will be doubled. The Lexington Ave. station will have its capacity increased from 10,000 to 20,000 lights. The capacity of the Gwinnett St. station is 25,000 or 30,000. There will be laid between 20 and 25 miles of mains. The commissioner of city works will receive bids until March 13 for electric lights for streets and public buildings for the year 1893.

NEW YORK, N. Y.—The department of public charities will receive bids until March 16 for an electric light plant at Central Islip, Long Island; also for one on Ward's Island.

BILOXI, MISS.—The city has granted a franchise to E. G. Bucklin for an electric light plant, which will be constructed as soon as possible.

HARRIMAN, TENN.—An election will be held March 9 to vote on the issue of bonds for $15,000 for electric lights, and $50,000 for water-works.

NASHVILLE, TENN.—The board of public works has been instructed to prepare specifications and advertise for bids for furnishing the city with electric lighting, the price not to exceed 24 cts. per light per night.

LINWOOD, O.—Geo. Hornung, Cincinnati, has been engaged to prepare surveys and plans for an electric light plant and water-works.

OBERLIN, O.—We are informed by W. B. Gerrish, Consulting Engr., that at an election to be held April 3 the citizens will vote on the issue of bonds for $9,000 for an electric light plant, to be run in connection with the water-works.

MOUNT CARMEL, ILL.—W. S. Reed & Co., Chicago, have been awarded the contract for putting in an electric lighting plant in connection with the water-works. The plant will consist of a 35-arc light dynamo for street lighting, and a 500-incandescent light dynamo for commercial lighting.

EDWARDSVILLE, ILL.—The Edwardsville Electric Light & Power Co. has been awarded the contract for city lighting at $80 per light per year for 2,000-c. p. lights, the lights to burn all night.

TOPEKA, KAN.—The city has granted a charter to the Chicago-Topeka Light, Heat & Power Co., referred to in our issue of Feb. 9. The capital stock is $1,200,000, and among the directors are J. B. Payne, Lucien Clark and E. C. Gibson. It is claimed that the proposed dam can be constructed in about six months. J. T. Fanning, Minneapolis, Minn., is the engineer of the company.

PENDLETON, ORE.—The Pendleton Electric Light & Power Co. will purchase $14,000 worth of new machinery, including a 200-HP. Corliss engine.

WENATCHEE, WASH.—The city council is discussing a plan for electric street lighting.

NEW COMPANIES.—Jersey Shore Electric Light, Heat & Power Co., Jersey Shore, Pa.; $5,000; Treas., H. B. Humes. Automatic Electric Lights Extinguishing Co., Baltimore, Md.; $10,000; G. M. Hughes, G. T. Hughes, T. M. Dobbin. Elwell-Parker Electric Construction Co., Chicago, Ill.; $500,000; C. Phillips, R. L. Tatham, Chas. R. Webster.

CONTRACT PRICES.

BRICK, CEMENT AND DRAIN PIPE.—Halifax, N. S.—F. W. W. Doane, Cy. Engr., informs us that a contract for brick has been awarded to the International Brick & Tile Co., at $8.30 per M. The lowest bid for Portland cement was that of Black Bros. & Co., $2.35 per bbl. of 400 lbs. for Coronet brand. The contract for drain pipe was awarded to F. Hyde & Co., for Scotch pipe, as follows: 6 and 9-in. slants, 38 and 57 cts. each; 6 and 9-in. straight pipe, 35 and 53 cts. per yd; 6 and 9-in. traps, $1.25 and $1.85 each; 6 and 9-in. bends, 45 and 78 cts. each; 3-in. drain tile, 2¾ cts.

DREDGING.—Buffalo, N. Y.—The following bids for dredging have been opened by the board of public works: Hingston & Woods, Buffalo Harbor and Peck's Slip, 18 cts. per cu. yd.; Buffalo Harbor and Blackwell Canal, 18.5 cts.; deepening Buffalo River, between Aurora and Hamburg Sts., to 19 ft., 34 cts. and $2.98 for earth and rock excavation, respectively. Thos. Hickler bid 50 cts. and $3.50 for the latter work.

Oakland, Cal.—The Von Schmidt Dredging Co. will remove 450,000 cu. yds. from Oakland Harbor, at 40 cts. per cu. yd., the work to be completed in eight months.

STONE.—Astoria, Ore.—Fifteen bids were received for furnishing 100,000 tons of rock on board of government barges for the jetty at the mouth of the Columbia River, the lowest ones being as follows: Maxwell & Huber, Spokane, Wash., 63 cts. per ton; Daniel Kern, Portland, 65 cts.; W. Jacobson, 65 cts.; Perry Hinkle, 78 cts.

Newport, R. I.—Capt. W. H. Bixby, U. S. Engineer Office, has received the following bids for stone for the harbor of refuge, at Point Judith: Chas. W. Johnston and Enoch Townsend, Somers Point, N. J., $1.73 per ton of 2,000 lbs. for core stone, and $1.75 for facing; Hughes Bros. & Bangs, Syracuse, N. Y., $1.27½ for each; Humphrey Toomey, Guilford, Conn., $1.95 for each. About $75,000 is available for the work this year.

ASPHALT PAVING.—Detroit, Mich.—The contract for paving a part of Woodward Ave. with asphalt has been awarded to O. E. C. Guelich, representing the Bermudez Asphalt Co., at $2.78 per sq. yd.; total amount, about $140,000.

ASPHALT BLOCK PAVING.—York, Pa.—The following bids have been received for paving about 10,000 sq. yds. with asphalt blocks, on a 6-in. concrete foundation; J. U. Fritchey, Lancaster, $2.56 per sq. yd.; McAdams & Co., Pottsville, $2.79; Jas. F. Ward & Co., Harrisburg, $2.82¼; Odenwalt & Huber, York, $2.77; R. S. Oster & Bro., Lancaster, $3.05. We are informed by J. G. Durbin, C. E., that the contract has been awarded to Mr. Fritchey.

CEDAR BLOCK PAVING.—Oskosh, Wis.—The lowest bids for grading, curbing and paving with cedar blocks in six streets were those of John Laabs and Alex. Gallinger, as follows: Grading, 23 to 30 cts. per cu. yd.; curbing, 38 and 40 cts. per lin. ft. for 3 and 4-in., respectively; paving, 67⅝ to 69⅝ per sq. yd.; total amount, about $53,000. These bids are the lowest the city has ever received.

BRICK PAVING.—Canton, Ill.—The contract for about two miles of brick paving has been awarded to Davis & Dougherty, Bellaire, O., as follows: Excavation, about 10,400 cu. yds., 23 cts. per cu. yd.; stone curbing, 20,613 lin. ft., 54 cts. per lin. ft.; paving, 50,435 sq. yds., $1.64 for Galesburg brick, and $1.49 for Canton brick. It is intended to use Canton brick as much as possible, the available supply being estimated at 3,000,000 brick, or about half of what will be needed. The work is to be completed by August.

WATER DISTRIBUTION SYSTEM AND PUMPING STATION.—Atlantic Highlands, N. J.—The following total bids were received for a water distribution system and pumping station: 1, Conover & Newton, $35,620; 2, Thos. J. Regan, $38,607; 3, T. & B. Brady, $47,269; 4, John B. Foley, $30,801; 5, P. H. Harrison, $33,190; 6, Inman Bros., $30,941; 7, Hilipot & Ayres, $33,613. C. P. Bassett, Orange, is engineer in charge. The contract was awarded to Hilipot & Ayres, and the prices were as follows:

	1.	2.	3.	4	5.	6.	7.
10-in. pipe, 5,730 lin. ft., at	$1.05	$1.07	$1.35	$ .88	$ .94	$ .90	$ .995
8-in. " 3,640 " "	.89	.89	1.17	.747	.80	.73	.85
6-in. " 12,740 " "	.62	.69	.85	.534	.56	.52	.595
4-in. " 20,180 " "	.41	.49	.62	.362	.40	.39	.395
10-in. valves and boxes, 12, at	37.00	35.00	39.25	28.04	30.60	27.00	30.00
8-in. " " 8, "	28.00	27.00	29.59	21.30	22.80	21.00	23.00
6-in. " " 49, "	21.00	20.00	22.33	15.32	16.60	15.00	17.00
4-in. " " 37, "	16.00	16.00	16.59	10.74	12.15	12.00	13.00
Hydrants, 75, at	30.00	29.00	42.00	25.75	22.25	24.00	23.50
Special castings, 8,000 lbs., at	.06	.02	.06	.024	.02	.03	.025
10-in. straps, 40, at	3.00	2.50	2.00	1.50	1.97	.75	.25
8 in. " 40, "	3.00	2.50	2.00	1.50	1.73	.75	.20
6-in. " 40, "	2.00	2.00	2.00	1.50	1.29	.50	.15
4-in. " 40, "	2.00	1.50	2.00	1.50	.86	.50	.10
Rock excavation, 50 cu. yds., at	.25	5.00	3.00	1.80	2.00	.01	1.00
Extra " 50 " "	.20	2.00	.75	.47	.20	.40	.35
Pumping station	4,750.00	5,325.00	5,380.00	4,800.00	5,700.00	4,800.00	5,350.00

SEWERS.—Boston, Mass.—Bids were opened Feb. 25 by the metropolitan sewerage commission for section 46 of the main sewer, in Winchester, Woburn and Stoneham. The total bids were as follows: 1, Jones & Meehan, Jamaica Plain, $19,752; 2, F. A. Snow, Providence, R. I., $18,985; 3, A. W. Byrne, Somerville, $17,830; 4, Wm. B. Byrne, Everett, $17,127; 5, National Construction Co., Boston, Mass., $16,780; 6, Dennis O'Connell, Dorchester, $15,957; 7, Lindsay & Cudmore, Somerville, $15,786; 8, Frank L. Allen, Worcester, $14,961; 9, Everson & Liddle, Providence, R. I., $14,407; 10, Chas. Linehan, Cambridgeport, $13,781.

The prices ranged as follows: Earth excavation and refill for 2,375 lin. ft. of sewer, 22 × 27 ins., 94 cts. to $2.10 per lin ft.; for 1,075 lin. ft., 18 × 24 ins., 94 cts. to $1.90; for 2,300 lin. ft., 15-in. pipe, $1.30 to $2; brick masonry, American, 220 cu. yds., $12 to $15 per cu. yd.; Portland, 150 cu. yds., $14 to $17; concrete masonry, American, 200 cu. yds., $4.75 to $6; Portland, 100 cu. yds., $6 to $8; spruce lumber in place, 10,000 ft. B. M., $25 to $45 per M. ft.

Jamestown, N. Y.—The following are the more important prices of the contract which we noted in our issue of Feb. 16, as awarded to W. H. Roberts, Pittsburg, Pa., at $42,670: Tile sewer, 24, 20, 18, 15, 12, 10, 9 and 8-in., $1.70, $1.50, $1.30, $1.05, $1.85, 75 cts., 73 cts. and 70 cts. per lin. ft., respectively; iron sewer, 24, 20, 18, 16, 12 and 10-in., $4.75, $4.50, $3.50, $3.15, $2.40 and $2.10; manholes, 920 vert. ft., $4.15; flush tanks, 170, $10; gravel, 60 cts. per cu. yd.; concrete, $4; brick, $16 per M.; oak and pine, $20; piling, 500 ft., 20 cts.; 12-in. gate, $50; 4-in. house connections, 55 cts. per lin. ft.

Ironton, O.—In our issue of last week the Pawtucket item, with table, bisects the item relating to this city, instead of wholly preceding it, as it should.

MISCELLANEOUS.

GAS LIGHTING.—Troy, N. Y.—The Troy Gas Light Co. has been awarded the contracts for lighting the public buildings at $1.50 per 1,000 ft., and for about 280 street lamps at 8 cts. each per night.

GAS FRANCHISE.—Menominee, Mich.—The city council has granted a franchise to a local company, which will commence at once the construction of a plant; capital stock, $50,000.

GRANITE WORK.—Rockland, Me.—The Bodwell Granite Co. has been awarded the contract for about $500,000 worth of granite work for the new post-office building at Washington, D. C. The work will be done at Vinal Haven, and will employ a large crew of cutters for over two years.

STONE.—Vincennes, Ind.—The city clerk will receive bids until March 13 for stone for five culverts.

BOILER, ETC.—Baltimore, Md.—The mayor will receive bids until March 16 for new boiler, etc., for quarantine tug Hygeia.

JETTY WORK.—San Diego, Cal.—Plans have been prepared for a jetty to cost about $500,000. It is reported that the work will be advertised immediately.

LOCK AND DAM.—Charleston, W. Va.—The lowest bids received Feb. 23 and March 2 for building locks Nos. 10 and 11 of the Great Kanawha River improvement, and the movable dams connected therewith, were those of Humphrey Devereux, Shawneetown, Ill., $230,053 and $488,725, respectively. More detailed prices will be published next week.

FIRE ENGINES.—New York, N. Y.—The fire department will receive bids until March 22 for steam fire engines as follows: Two first size, with M. R. Clapp's coil tube boilers; 2 extra second size, and 1 third size, with La France's improved nest tube boilers.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Schenectady Locomotive Works, Schenectady, N. Y., are building 30 switching engines for the Union Stock Yards, Chicago, and 10 passenger engines for the Michigan Central. The Pittsburg Locomotive Works, Pittsburg, Pa., are building 8 ten-wheel freight engines for the Pittsburg, Shenango & Lake Erie, and 3 two-cylinder compound tank engines for the Brooklyn Elevated. The Rogers Locomotive & Machine Works, Paterson, N. J., have increased the capital stock to $3,000,000; they have an order for 8 suburban locomotives for the Illinois Central. The Delaware, Lackawanna & Western is building a ten-wheel fast freight engine for hauling the milk trains; cylinders, 24-in. stroke; driving wheels, 5 ft. 2 ins.; firebox, 10 × 4 ft.; tubes, 288; boiler pressure, 165 lbs. The New York, New Haven & Hartford has ordered 4 ten-wheel freight engines; the road will receive 30 new engines from the builders this month.

CARS.—The South Baltimore Car Co., Baltimore, Md., has an order for 50 coal cars of 60,000-lb. capacity. The Billmeyer & Small Co., York, Pa., has an order for 30 passenger cars for the Illinois Central. The United States Rolling Stock Co., Hegewisch, Ill., has an order for 200 coal cars for the Chicago & Calumet. The Ohio Falls Car Co., Jeffersonville, Ind., has an order for 20 suburban cars for the Chicago & Northern Pacific. The Pullman Palace Car Co., Chicago, Ill., has built two compartment sleeping cars for the Illinois Central; there are five compartments on each side, finished in different colors and styles. The New York Central will add 1,200 freight cars to its equipment. The Northwestern Car Co., Detroit, Mich., is reported as offering to remove to Oshkosh, Wis., if the city donates 25 acres and $25,000. The Woeber Bros. Car Works, Denver, Colo., were burned Feb. 22, and several street cars were destroyed.

MORTARS.—The Builders' Iron Foundry, Providence, R. I., has the contract for 28 spring return carriages for 12-in. breech-loading rifle mortars. These carriages weigh about 42 tons each, and are to be used for coast defense in connection with the rifled mortars made by this company.

NEW WORKS.—The Mason Air Brake & Signal Co., Chicago, Ill., will establish its works at Elgin, Ill. The main building is 100 × 300 ft.; iron foundry, 30 × 100 ft.; brass foundry, 30 × 60 ft. The buildings are of brick and stone, lighted with electricity. The steam power plant consists of four 80-HP. boilers, fire and feed pump, and a 250-HP. Corliss engine. Estimated cost of the plant and equipment, $100,000. The Mason signal is said to have been adopted on the Chicago, Milwaukee & St. Paul R. R., and to be tried on several other roads. President, J. R. Mason; Mechanical Engineer and inventor, H. R. Mason; Secretary, O. C. Mason. The offices are in the Insurance Exchange Building, Chicago. The Young & Willover Automatic Block Signal Co. will put up a brick building 100 × 300 ft., at Pottstown, Pa., to manufacture its appliances.

THE DEANE STEAM PUMP CO., Holyoke, Mass., has increased its capital stock by $100,000, making a total of $300,000.

QUEEN & CO., Philadelphia, Pa., are introducing the Bacheldor steam engine indicator, which is said to be a new departure from all other forms, the important feature being the flat adjustable spring by which the change can be made from one scale to another by a simple adjustment of the fulcrum, thus avoiding the extra expense and necessity of carrying a series of spiral springs. The firm has also put on the market a line of steam and pressure gages of its own make, for which it claims great accuracy.

THE GOULDS MFG. CO., Seneca Falls, N. Y., reports several recent installations of its triplex power pumps for running hydraulic elevators, furnishing water supply, etc. One of these pumps, operated by a 25-HP. motor, runs two elevators in A. Schwartz & Co.'s building at New Orleans, another in the Fireman's Insurance Building, at Baltimore, and another in the Oregonian Building, Portland, Ore. They are also in use at the Fulton Worsted Mills, Fulton, N. Y.; the State Industrial Schools, Rochester, N. Y., and at the water-works, of San Antonio, Tex.

THE BUCYRUS STEAM SHOVEL & DREDGE CO.'S new works at South Milwaukee, Wis., will be started up very soon. The company states that it has over $200,000 worth of unfilled orders on the books and more coming in. Its bid to the government for a large suction dredge, for use on the Mississippi, Red and Atchafalaya rivers, has been accepted by the War Department. The contract price was $69,500, and the dredge will be very complete and of an original design. Recently completed orders comprise a large combination dredge for the Plant Investment Co., at Port Tampa, Fla., which will cost about $80,000, and a large number of other dredges of various types, besides the regular steam shovel work.

THE STEARNS MFG. CO., of Erie, Pa., through its Chicago office, Mr. D. J. Lewis, Mechanical Engineer, has been awarded the contract for a stand-pipe, 16 × 100 ft., and two 54 × 14-ft. boilers, with connections, for the water-works and electric light plant at Mt. Carmel, Ill. W. S. Reed & Co., Chicago, are the contractors for the whole plant. It has also been awarded the contract for a 5 × 70-ft. water-works stand-pipe, and two, 54 × 14-fto boilers, with a 60-ft. stack and connections, at West Knoxville, Tenn. Geo. W. Sturtevant, Jr., Chicago, is the engineer.

PROVINCETOWN WATER-WORKS, MASS.

Sealed proposals will be received until 2 p. m., Tuesday, March 28, 1893, by the Board of Water Commissioners of Provincetown, Mass., for furnishing and erecting the following: A brick pumping station, coal shed and chimney; a duplicate pumping plant of about 2,000,000 gallons capacity; a granite foundation for the stand-pipe, 32 ft. in diameter by 12 ft. high; and a wrought iron reservoir, 28 ft. in diameter by 100 ft. high.

Plans and specifications are at the office of the engineer, No. 75 State St., Boston. The right is reserved to reject any and all bids.

LYSANDER N. PAINE,
A. LOUIS PUTNAM,
JOHN D. ADAMS,
Water Commissioners.
LOUIS HAWES, Engineer.
Provincetown, Mass., March 9, 1893.
10-2t

TREASURY DEPARTMENT, OFFICE Supervising Architect, Washington, D. C., March 8th, 1893.—Sealed proposals will be received at this office until 2 o'clock p. m. on the 29th day of March, 1893, and opened immediately thereafter, for all the labor and materials required for floor arches, concrete filling, etc., for the U. S. Post Office, Court House, etc., building at Troy, New York, in accordance with drawings and specification, copies of which may be had at this office, or the office of the Superintendent, at Troy, New York. Each bid must be accompanied by a certified check for a sum not less than 2½ of the amount of the proposal. The right is reserved to reject any and all bids, and to waive any defect or informality in any bid, if it be deemed in the interest of the Government to do so. All bids received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Floor Arches, Concrete Filling, Etc., for the U. S. Post Office, Court House, Etc., Building at Troy, New York," and addressed to W. J. EDBROOKE, Supervising Architect. 10-2t